SNAP TO READ

INTEGRATING ARTIFICIAL INTELLIGENCE TO SUPPORT READING COMPREHENSION IN INDONESIAN EFL CONTEXTS

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First received: July 31, 2026 Final proof received: September 21, 2026

Abstract:
The article describes the use of AI-based tools for English reading comprehension teaching among Indonesian EFL learners. This study addresses the perennial reading challenges caused by limited lexical knowledge, inconsistent access to English, large class sizes, and limited individual feedback in the Indonesian university context. Although previous studies have investigated single AI tools or the general motivational effects of AI on language learning, little is known about how several complementary AI tools can be combined within one teacher-mediated reading cycle and evaluated through a mixed-methods design in an Indonesian university classroom. The novelty of this study lies in addressing that gap by integrationg four complementary tools into a single, theory-driven reading cycle and triangulating quantitative gains with qualitative evidence of learners' experience. Twenty-eight undergraduate students of a Reading class of the Ushuluddin Faculty, UIN Sayyid Ali Rahmatullah Tulungagung, employed 4 AI-based applications for one semester in a mixed-methods classroom intervention: Text Inspector for text and lexical analysis, ReadTheory for an adaptive reading practice, Rewordify for vocabulary assistance, and Quillionz for the automation of comprehension questions. Quantitative results revealed that the post-test mean score was 80.1 (SD = 6.5) as compared to the pre-test mean score of 61.2 (SD=12.3); with a mean gain of 18.9. Qualitative

results from students' reflection journals, teachers' observations, and students' focus group interviews found that the tools enhanced students' confidence, strategic reading behaviours, peer interaction, and autonomy in learning. Through interactive reading theory, schema theory, vocabulary learning theory, sociocultural scaffolding, adaptive learning and formative assessment, findings have demonstrated that AI-based tools are educationally beneficial if implemented with teacher mediation, clear instructions on explicit learning strategies, and mindful use of data. This finsings indicate that AI-based reading instruction could offer consistent and individualized scaffolding to Indonesian EFL learners in addition to careful design, digital accessibility and ongoing assessments across educational fields. In conclusion, integrating multiple complementary AI tools into a teacher-mediated reading cycle can be effective, theoritically grounded strategy for enhancing EFL reading comprehension, engagement, and autonomy in the Indonesian higher education context, provided that implementation attends to equitable access and responsible use of learner data.

Keywords:
artificial intelligence; reading comprehension; Indonesian EFL; adaptive learning; vocabulary support

INTRODUCTION

Reading comprehension is central to English as a Foreign Language (EFL) instruction because reading is a tool that allows students to gain access to academic texts, navigate the information that circulates within the digital landscape, and acquire wider communicative competence. For Indonesian learners, however, reading in English is still generally a difficult task. Students need to overcome obstacles such as decoding unknown words, understanding complex grammatical structures that are not similar to Indonesian, linking pieces of information in different parts of the text, and activating schematic or disciplinary knowledge that may not be accessible at the moment of reading. The problems are more obvious when the text is a more academic or semi-academic discourse which asks the readers to make

inference, critically assess, and integrate information rather than translating every word individually.

English plays an important role in Indonesian education (both school and higher education) and can also be found as a medium of instruction in some academic contexts and as a vehicle for information and communication in some specific disciplines and professional and digital contexts. Outside these areas, however, it is not generally used as a medium of communication for everyday life. In such circumstances, Indonesia is better characterized as an EFL context than as an English as a Second Language context. In an EFL context, learners typically rely on the information they receive from the classroom instruction and additional exposure of their own (like listening to movies, reading internet content), which can result in differentiated language acquisition among students. Reports about English language education in Indonesia continue to highlight unevenness in policy implementation, teacher education, learner attainment, and classroom working conditions (Zein et al., 2020). So far, studies on English reading instruction in Indonesia have identified problems faced by students in the areas of vocabulary knowledge, reading strategies, text organization, motivation, among others (Cahyono & Widiati, 2006; Hamra & Syatriana, 2010).

These problems were not only related to the linguistic side, but also the pedagogical and institutional aspects. It is not feasible for a lecturer to individually supervise every single student given the large class sizes. Different students arrive at the university with different levels of exposure to the English language and with different levels of digital literacy and confidence. Although the conventional grammar-translation method is useful in promoting language form, it is generally not conducive in developing high-order comprehension ability. Consequently, some students may have excellent skills in sentence translation but poor ability to find main idea, make inferences, and critically evaluate text contents.

The rise of digital technology use in higher education is pushing the demand for English reading skill to an even higher level of urgency.

DOI: dx.doi.org/10.21274/ls.2026.18.2.231-265

University students are asked to read English academic journals, e-learning materials, institutional websites, official documents, and relevant web resources for their discipline. Reading comprehension, then, is not only a language learning goal but has broader implications for accessing academic materials, joining global information network, and preparation for professions where English is a major tool for knowledge transfer. Indonesia has been consistently categorized as the low-proficiency band according to the EF English Proficiency Index report of 2023, thus reinforcing the need for a practical and scalable English reading support (EF Education First, 2023).

An AI-supported system is one of the alternatives. AI tools may help with text difficulty analysis, automatic adjustment of the text level according to the student's performance, instant vocabulary explanations, automated comprehension question generation, and frequent formative feedback which a teacher may not be able to offer in a large class. While an AI-supported system cannot substitute the role of a teacher, it could augment their instructional capacity to differentiate instruction and monitor individual students' learning and increase opportunities for students' individual practice with reading. As noted, the use of AI tools in the area of language learning, among others, is increasingly discussed for its potential to support learners' motivation, self-regulated learning and learning outcomes when properly aligned with instructional goals (Wei, 2023). More recently, AI-mediated formative assessment has been linked to gains in reading proficiency and academic engagement (Alazemi, 2024), while reviews of intelligent language-learning assistants caution that many available tools remain limited in contextual accuracy and are rarely evaluated within an integrated classroom pedagogy (Kulkuska-Hulma & Lee, 2020).

Taken together, these strands of research show that AI-supported language learning has mostly been examined in terms of single-tool effectiveness or general effects on motivation and self-regulated learning, with little attention paid to how several complementary AI tools might be sequenced into one coherent reading cycle, or to how such integration

performs when evaluated through mixed-methods design that combines measurable comprehension gains with classroom-based qualitative evidence; this is the research gap addressed by the present study. This gap is particularly consequential in Indonesia, where reading instruction must contend with large class sizes, uneven access to digital resources, and a persistently low national English-proficiency ranking (EF Education First, 2023), so that a classroom-embedded, teacher-mediated model of AI use is needed that lecturers can realistically adopt without specialised infrastructure or one-to-one technology access. Unlike earlier AI-EFL studies that typically evaluate a single application in isolation, the present study differs by combining four complementary tools: TextInspector, ReadTheory, Rewordify, and Quillionz, each assigned to a distinct phase of the reading process (pre-reading diagnosis, adaptive practice, lexical scaffolding, and post-reading assessment), and by triangulating quantitative test-score gains with qualitative evidence of engagement, confidence, and autonomy. This combination of a multi-tool reading cycle with mixed-methods triangulation, situated in an under-researched Indonesian university setting, constitutes the novelty and contribution of the present study.

This article is a rewriting and enhancement of classroom-based research conducted with university students learning EFL in an Indonesian higher education institution. It reports the application of four specific AI-supported tools: Text Inspector, ReadTheory, Rewordify and Quillionz, each providing different types of reading-support functionality, which are: lexical and structural analysis of the text, adapted learning of reading, vocabulary support, and automatically generated comprehension questions. The focus of the article is to share the way in which those tools could foster learners' reading comprehension, their autonomy and participation in the classroom when embedded in a teacher-mediated instructional approach.

The research question that drives this article is: How can AI-supported applications be implemented in Indonesian EFL reading instruction to enhance comprehension, engagement and autonomy of learners? Specifically,

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this study aims to (1) examine the extent to which a sequenced, multi-tool AI intervention is associated with change in students' reading comprehension scores, and (2) explore how students experience, engage with, and develop autonomy through the intervention, as reported in their reflections, classroom behaviour, and focus-group discussions. In answering this question, this article connects the intervention to theories of reading, vocabulary acquisition, sociocultural scaffolding, adaptive learning, and formative assessment, before moving on to describe the research design, findings, discussion, conclusion, limitations and recommendations for further studies.

Review of Literature

A conceptually-driven perspective is required, for it must be noted that AI is not a pedagogy. It only becomes an educational tool when it can be said to support recognizable learning processes. As reading comprehension instruction is concerned, these processes can include word recognition/decoding, vocabulary development, background-knowledge activation, inferencing, comprehension monitoring, and meaning validation. The following paper then construes AI-supported reading from several, overlapping lenses.

The first is an interactive view of reading: Rumelhart (1977) posited that reading is not simply a movement from letters to meaning but rather an interaction of information sources. Second-language reading, in this view, has been characterized by Grabe (2009) as "a multifaceted process integrating lower-order processing... With higher-order cognitive processes of inference, comprehension monitoring and text interpretation". An AI approach to reading may support lower and higher order processing: tools could help students to notice lexical density, sentence complexity and common features (text-analysis tools); they may also allow students to practice comprehension skills at the appropriate level (adaptive reading tools).

The second lens is that of schema theory: A reader is said to comprehend a text by relating its elements to prior schemata (Anderson & Pearson, 1984). Carrell and Eisterhold (1983) applied this to SLA reading

pedagogy, explaining that comprehension is not solely a matter of lexical and grammatical knowledge, but it is also concerned with culture, topic and discourse knowledge. Indonesian EFL learners might not recognize the cultural and topical context of an English text. AI may help teachers to identify schemata that should be activated in pre-reading stages, and it may also help students to predict what will be read in a text by pre-introducing words.

The third view relates to the theory of vocabulary learning: According to Nation (2013), knowledge of words is built upon repeated, varied, and meaning-rich exposure. Lexical coverage has a significant impact on reading comprehension; "when the number of unknown words reaches a certain point, reading can cease to be comprehensible, and the reader can direct little cognitive resource towards understanding the passage globally". It can be observed that vocabulary-support tools (e.g. Rewordify) reduce these obstacles by simplifying or explaining words in context. This type of intervention, however, requires pedagogical caution: it should not lead to a mere paraphrasing of words which fails to build enduring word knowledge, but must include teacher guidance for the processing of new words, practice of strategies, and autonomous vocabulary acquisition.

The fourth perspective is that of sociocu ltural theory and scaffolding: Vygotsky (1978) stated that learning is a process that develops within the zone of proximal development and is mediated through social interaction. The "mediational means" may be teachers, peers, tasks or tools, such as AI. Nevertheless, the tools themselves mustn't be viewed as independent sources of learning. Social constructivism advocates for guided activities in which students can interpret data, negotiate meanings and learn to apply skills, such as reading skills, from mediated to unmediated contexts. This suggests that AI should be considered a part of an entire support system involving teacher mediation and collaborative work.

The fifth viewpoint is adaptive learning and formative assessment. Adaptive learning platforms adjust the level of the task to the learner's abilities, while formative assessment refers to information that allows students

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and teachers to decide on the next actions to take. An example is ReadTheory, a tool that automatically modifies reading passages and questions to a reader's skill level, or Quillionz, which may assist the student in checking their understanding and revising. These tools may help to make assessment more frequent and less based on periodic tests. However, formative assessment requires teachers to actively analyze the feedback provided by the tool, integrate this with their own observation of the learners and guide students toward setting achievable learning objectives.

Both the promise and the peril of AI in education are documented: A systematic review on AI in higher education concluded that most applications relate to prediction, assessment, adaptive learning and intelligent tutoring, while the role of the educator is sometimes minimized (Zawacki-Richter et al., 2019). For AI in education, it is important to be human-centred, transparent, fair and mindful of the need to protect user data (Holmes et al., 2021). Studies into AI in language learning have demonstrated that AI applications may increase motivation and self-regulated learning (Wei, 2023), and have more recently explored how formative assessment with AI contributes to reading proficiency and academic engagement (Alazemi, 2024). This is all to say that AI is capable of facilitating learning, but requires pedagogical understanding and a responsible implementation.

The caveat of digital technology, particularly AI, in Indonesia EFL reading education context should be strongly emphasized: If not all students possess regular access to the internet, a computer, and the skills to operate online platforms, AI may be a source of unequal access. Similarly, AI-generated interpretations or definitions can be erroneous or misleading in the context of a specific culture. Teachers must consider these limitations and encourage critical reflection towards tool-generated responses and train students not to view technology as an authoritative source. The teacher's role in such technology-mediated learning is to become more of a facilitator of discussion and critical thinking.

AI Tools Used in the Intervention

Four AI or AI-supported tools were used in the intervention. Each tool was aligned with different aspects of the reading lesson: Text Inspector was primarily used before reading to review difficulty, vocabulary profile, and lexical demands (Text Inspector, 2026). ReadTheory was used for reading practice since it offers levelled texts, comprehension questions and an adaptive progression (ReadTheory, 2026). Rewordify was used for lexical support and helped students to navigate the difficult terms or phrases in the text (Rewordify, 2026). Quillionz was used for post-reading assessment to gauge comprehension (Quillionz, 2026).

The tools chosen for this intervention were selected for their complementary rather than repetitive functionality. Text Inspector addresses pre-reading and instructional design, ReadTheory promotes practice and progression, Rewordify offers support with lexical items during reading, and Quillionz facilitates a post-reading check and metacognition. Together, the tools create a reading cycle that begins with text preview, continues with reading practice and vocabulary development, and ends with assessment and review. This cycle is a significant aspect of the intervention as it helps prevent a purely gaming approach to the AI and provides students with multiple interactions with the texts they are reading.

The use of all four tools proved valuable in the context of a diverse university-level course since it allows students to learn individually while following the same lesson structure. Lower-level students were able to receive help with lexical items and comprehension without having to wait for the instructor to review each word. Higher-level students could continue to build on their abilities. Teachers were able to monitor students' progress through platform reporting and make appropriate instructional decisions based on common areas of difficulty.

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Table 1. Pedagogical Functions and Theoretical Alignment of the AI Tools

Tool	Main classroom function	Theoretical alignment
Text Inspector	Analyzes lexical and textual difficulty before reading.	Interactive reading; schema activation; content analysis.
ReadTheory	Provides adaptive reading passages and comprehension feedback.	Adaptive learning; formative assessment; self-regulated practice.
Rewordify	Explains or simplifies difficult vocabulary in context.	Vocabulary learning; scaffolding; lexical access.
Quillionz	Generates comprehension questions for review and monitoring.	Formative assessment; metacognition; comprehension monitoring.

METHOD

A mixed-methods, classroom-based design was adopted to address both quantifiable reading gains and students; experiences with AI-supported reading instruction. Specifically, the study employed a convergent (concurrent) parallel mixed-methods design (Cresswell & Plano Clark, 2018), in which quantitative data (pre- and post-test scores and tool-use logs) and qualitative data (reflection journals, classroom observations, and focus-group interviews) were collected during the same intervention period, analyzed separately according to their respective procedures, and then integrated at the interpretation stage: qualitative themes were used to explain and contextualize the quantitative comprehension gains, while the quantitative results were used to check whether patterns reported qualitative, such as gains in confidence and autonomy-corresponded with observable changes in scores. A mixed-methods design was appropriate, not only because it was crucial to determine if students' reading comprehension scores improved, but because it was important to explore and understand how students felt when using digital scaffolds to help their reading comprehension (Cresswell

& Plano Clark, 2018). The quantitative component focused on both changes in students' reading comprehension scores, and the frequency with which students used the AI tools. The qualitative component aimed to gain insight into students' feelings, reading strategies, reading confidence, and classroom interaction throughout the intervention.

Respondents

Twenty-eight undergraduate EFL students in a Reading course at the Ushuluddin Faculty, UIN Sayyid Ali Rahmatullah Tulungagung, Indonesia, were involved in this study. The class was intentionally selected because it represented a typical Indonesian university EFL setting, where students have varying levels of vocabulary and reading confidence and limited prior experience with digital tools. This whole class was selected as a sample so that the intervention could be implemented as part of their regular class time, not a separate lab setting. This increases ecological validity because students were tested using AI tools with the constraints of actual classroom time, mixed abilities, peer interaction, and natural teacher mediation.

Instruments

The additional evidence for these areas was gathered from several instruments. Firstly, there was the reading comprehension test. This test was given as both pre- and post-intervention to measure baseline level and change following the AI-supported learning cycle. The dimensions measured were common areas in EFL reading comprehension (main ideas, explicit information retrieval, inferencing, vocabulary in context, structure of the text, and conclusions drawn) using short, academic or semi-academic texts. These dimensions were chosen because they involve interaction between the top-down and bottom-up reading processes that interact with each other in interactive models of reading (Grabe, 2009; Rumelhart, 1977). Secondly, there was the set of AI-supported platforms that was used both to guide learning and as a source of evidence of learning. Text Inspector provided information about lexical and textual complexity (vocabulary load, number of unique words, sentence length) and was used for previewing the text before

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reading. ReadTheory provided the adapted reading material and associated comprehension questions based on students' performance levels. Rewordify simplified vocabulary items and explained new vocabulary items within the context. Quillionz assisted in both generating questions after reading and in assessing comprehension. These platforms recorded different types of data (task completions, responses, skill level, interaction levels etc), but the analysis of data remained more pedagogical than purely algorithmic.

The third instrument was the student reflection journal, where students recorded their experience of reading and learning: which tools they used, which difficulties they encountered and how they had changed as readers and in confidence. It was found particularly important to use reflection journals because the test scores do not represent the full picture of reading development; they did not explain how and why the students chose certain tools, their reactions to feedback, or their developing autonomy. Fourthly, an observation sheet for the lecturer is used, in which class participation, group work, technical difficulties and changes in students' dependence on teacher-provided translations or explanations of the reading material were noted.

Finally, a semi-structured focus group interview guide was designed that posed open-ended questions about each of the AI tools, including the perceived advantages, disadvantages, motivation levels and student reading habits, as well as any recommendations for future work. I chose a semi-structured interview approach so that I would not exclude potentially surprising issues. Together, these tests, platform logs, reflection journals, observations and interviews offered a triangulated dataset that provided evidence of performance, practice and perception.

Procedures

The intervention was divided into three stages: preparatory (pre-intervention), execution (classroom use), and final (post-intervention). The preparatory stage included a description of the study to students and an overview of the principles of informed consent and anonymity, followed by administering the pre-test on reading comprehension. The students were

subsequently introduced to the four AI tools through direct demonstrations. This was necessary as the success of AI in language learning relies not only on student access to the AI tools but also their knowledge of when and how to appropriately use them.

During the execution stage, the AI tools were embedded in a repeated reading cycle. Students engaged in pre-reading by using Text Inspector to preview the text complexity, identify problematic vocabulary, and anticipate linguistic demands. While reading, students practiced reading for comprehension using Rewordify if their vocabulary level impeded comprehension, or used ReadTheory for targeted practice on reading for meaning and comprehension. After reading, students engaged in practice or review by using Quillionz to generate or respond to questions and clarify their comprehension. This ordering was designed to conform to existing reading practices: preparation before reading, teacher support during reading, and review and feedback post-reading.

Students did not view the AI tools as an autonomous form of learning. Instead, they were seen as integrated with explanations from the lecturer, classroom discussions and reflective practices. In class, students worked both individually and collaboratively and were able to question strategies, discuss challenging vocabulary, interpret feedback, and justify why certain answers were correct. For work outside of class, students engaged in extra activities involving these AI tools and recorded their learning experience in journals. This blend was developed to provide students with autonomy, while maintaining the social and interactive elements of language learning promoted by sociocultural theory (Vygotsky, 1978).

Students were continually monitored throughout the semester through class observations, student logs, brief assignments, and journaling. The lecturer continued to support students by providing additional help if they struggled to master the functionality or concepts related to the AI tools. For example, students were encouraged to check the vocabulary generated by Rewordify against the source text and to critically evaluate AI-generated

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comprehension questions from Quillionz. Finally, post-test scores were obtained, and students were interviewed for focus group data. The post-test served as a measure of learning, while the interviews and journal entries were intended to describe the processes of learning.

Data analysis

Data regarding student learning were obtained through analysis of quantitative data (student scores), qualitative data (reflections, observations, interviews) and descriptive statistics describing student engagement with the intervention tool-use data. The mean score improved from 61.2 on the pre-test to 80.1 on the post-test, an improvement of 18.9. Students logged an average of 59 activities in the tool and reported using an average of 3 out of 4 platforms (some students reported more than 4 activities logged per platform). Such descriptive data indicate not only whether the intervention has been learned, but also whether it is being learned in a sustained, distributed way.

If individual pre/post test scores were collected, then it may be possible to compare them statistically using a paired sample t-test, though these findings must be accompanied by appropriate confidence estimates, classroom context and descriptive qualitative evidence, not just statistical significance (Willms et al., 2014). Here, the data are reported as an aggregated mean score improvement and distributional information together with classroom learning evidence and patterns of student engagement. This strategy limits statistical certainty but illustrates concrete learning benefits without implying too great accuracy.

The qualitative interview, observation, and student journal data were analysed using a thematic approach (Braun & Clarke, 2006). The qualitative data were first read repeatedly to familiarise the researcher with students lived experiences and perspectives related to the technology intervention. These data were then coded to capture initial concepts and instances in which the students related their experiences of difficulty, vocabulary development, motivation, autonomy, and student interaction, among others, to specific use of or with the technology. Codes were then analysed and refined to create

higher-level themes about student changes, such as gained confidence, selection of technology tools strategically, less teacher dependence and an increase in metacognitive understanding.

Consistent with the study's convergent parallel design, the quantitative and qualitative strands were merged at this interpretive stage: the mean gain score supplied outcome-level evidence, while the qualitative themes supplied process-level evidence explaining how and why that gain occurred; convergence between the two strands was treated as strengthening confidence in a finding, whereas divergence was treated as a prompt for closer examination of context rather than being resolved in favour of either strand. Trustworthiness was developed by cross-validating data across different methods. Student statements about increased confidence, for example, were corroborated by observer notes that described students independently tackling challenging tasks, as well as by student activity data. Similarly, interpretation of engagement through activity logs, observation, student journal entries, and interview transcripts combined to paint a fuller picture, not merely to demonstrate frequency of activity. Negative or discordant instances were also sought, particularly in relation to technical issues and student variations in the utility of specific tools. Ethical considerations in this study are in keeping with ethical guidelines on learning analytics that advocate for the critical, cautious and ethical use of technology to support learning. Students were fully aware of how they were using the technology in the classroom setting and were never identified or individual scores revealed. Learning data obtained from the platform was not used for direct evaluation and the instructor was always solely responsible for its interpretation and application. Such practices ensure that learning analytics remain a supportive, not a punitive, tool for education.

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Table 2. Data Sources and Analytic Purposes

Data source	Purpose	Type of evidence
Pre- and post-reading assessments	Measured change in reading comprehension.	Quantitative outcome evidence.
Tool-use records and class logs	Documented engagement and frequency of use.	Quantitative and descriptive evidence.
Student reflection journals	Captured experiences, strategies, and confidence.	Qualitative experiential evidence.
Instructor observations	Recorded classroom behavior and participation.	Qualitative observational evidence.
Focus-group interviews	Explored perceptions of benefits and challenges.	Qualitative interpretive evidence.

FINDINGS AND DISCUSSION

The research results shows that the AI-supported reading instruction led to improvement in reading comprehension, continued engagement, and increased student autonomy. As this was an introductory, one-off class, results must be interpreted with caution; however, converging quantitative and qualitative data suggest that the intervention successfully addressed some of the salient problems of the Indonesian EFL reading classroom.

The most obvious quantitative evidence concerns the students' reading comprehension. Before the intervention, the class mean was 61.2; after the intervention, the class mean was 80.1; in other words, the mean gain was 18.9. Encouragingly, post-intervention, the number of students passing the task with an 80 or higher had nearly tripled. This demonstrates that the tools were equally helpful for students struggling with reading and those who were ready for a greater level of challenge. Since the provided data shows overall class, not individualized gains, the best interpretation of these results is as a demonstration of significant, positive shifts in the class rather than a conclusive causal statement.

Continued engagement with the tools was also an encouraging observation. Over the course of a semester, the students completed more

than 35 logged AI-supported activities each, and each student made ample use of all four tools. The participation in each application was remarkably uniform among all of the students. This is interesting because technology-enhanced learning can be of significant benefit to the most technologically adept and motivated learners, while not so much to others. This intervention evidently engaged a much broader swath of the class through support and clear demonstration.

The most interesting finding, however, was the varied utility of the different tools. Text Inspector appeared to be the most beneficial as a pre-reading strategy. Students were able to pre-assess the difficulty of texts and anticipate challenges, or look for important vocabulary. This provided students with an active strategy before tackling the reading text in the first place, instead of being dropped into the text "blind." Students found ReadTheory highly motivating as it could adapt to the students' individual levels and provide appropriate tasks. This is important because it helped learners work at their actual levels without providing texts that were either too easy or too difficult. Rewordify proved to be a useful tool for overcoming word-based difficulties, allowing students to tackle difficult academic texts without always having to rely on a teacher's translation. Finally, Quillionz provided an after-reading task for comprehension, helping students prepare for post-reading questions.

Confidence and learner agency appeared to increase from the qualitative findings. Students reflected in journals that they were willing to attempt texts they had previously avoided and were less prone to giving up when they hit a new word. Some students started to select tools to match their needs, such as using Text Inspector for preview, Rewordify for a new word, ReadTheory to practice, and Quillionz to check their understanding. The fact that some students began to use a tool for a specific task represents increasing metacognitive control because they are not just using tools the way the lecturer has assigned them, but are beginning to select tools for specific reading goals.

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Peer collaboration increased. Observation records noted that students offered one another help learning tools, interpreting tool feedback, and discussing their answers to problems. These peer relationships are a vital component to integrating AI-supported reading with human connection rather than placing students in isolation with their devices. Students were seen to have discussions and compare generated questions, debate which answer was best, and even translate words for each other based on their own understanding or through their use of tools. These interactions illustrate the potential of AI tools to serve as provocations for collaboration when tasks are designed to involve discussion and shared reflection.

The teacher noticed a change in the typical classroom interaction during the intervention. Students at the beginning of the semester would ask for straight translations or the right answer. By the middle of the semester, many students began to try to figure out what the tools were telling them before asking the teacher for clarification or the "right" answer. This, however, did not remove the teacher; it moved the teacher from the position of the main translator to the role of strategy consultant, feedback interpreter, and facilitator of discussion and these kinds of classroom exchanges and are consistent with the idea that AI should augment, not substitute, human instruction.

There were minor technical problems. Some students required assistance with the interface, logging in and interpreting the output of the tools. Students seemed to encounter these issues most often at the beginning of the intervention, and they became less pronounced over time as the students grew more familiar with the tools. This suggests the importance of orientation and guided introduction; a complete lack of instruction can make students either simply use tools rote or avoid them altogether.

Table 3. Summary of Main Findings

Finding area	Evidence from the study	Pedagogical meaning
Comprehension gain	Mean score increased from 61.2 to 80.1.	AI-supported scaffolding can support measurable reading improvement.
Engagement	Most students completed more than 35 logged activities.	Guided integration can sustain participation across proficiency levels.
Vocabulary support	Students used Rewordify to manage difficult words.	Lexical assistance can reduce dependence on teacher translation.
Adaptive practice	ReadTheory encouraged repeated practice and feedback use.	Personalized challenge can support motivation and persistence.
Autonomy	Students selected tools according to reading problems.	AI use can promote metacognitive strategy development.
Collaboration	Students assisted peers and discussed tool output.	Digital tools can stimulate social learning when tasks are mediated.

The results supported the hypothesis that AI tools can promote EFL readinginstructionwhen integrated into a cohesive teaching sequence. It is assumed that by reviewing texts, doing practice, checking vocabulary and monitoring comprehension repeatedly the students improved in reading from 61.2% to 80.1%. The results from the interview indicated why this happened: students were more motivated to practice reading independently and more aware of different strategies for dealing with texts; they developed greater confidence and became less passive when reading.

The results corroborated the interactive theory. There wasn't a single factor, but several ways that the tools aided reading. Awareness of textual and lexical difficulty was enhanced through Text Inspector; lexical knowledge was developed through Rewordify; practice of reading for comprehension occurred through ReadTheory; and monitoring of reading was facilitated through Quillionz. These aspects support the interactive approach that reading

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comprehension depends on the simultaneous coordination of bottom-up and top-down processes (Grabe, 2009; Rumelhart, 1977).

The results are also in line with schema theory. Students had a greater readiness for reading since they reviewed vocabulary and features of the texts beforehand. Reviewing vocabulary and textual features may have helped the students in activating their existing knowledge, and in hypothesizing the content of the texts. The assistance of these texts is especially important in EFL contexts where learners may lack sufficient background on the topics, cultural elements, or even vocabulary embedded within the texts (Anderson & Pearson, 1984; Carrell & Eisterhold, 1983).

Vocabulary was perhaps the most important factor the tool helped with. Most of the Indonesian EFL learners stopped reading whenever they encountered unknown vocabulary, due to a lack of confidence and interrupted flow. The fact that Rewordify assisted students to keep reading when they stumbled upon unknown words would be expected for these learners, and confirms Nation's (2013) theory that vocabulary acquisition needs repeated and contextualized exposure. However, the support of vocabulary should not just be limited to instant simplification of texts. It needs to be expanded with activities to record the words students learned, practice them across different tasks, and pay attention to collocations and usage in sentence level in order to promote long-term acquisition of lexis with AI tools.

The improvement in learners' autonomy can be viewed through sociocultural theory; the AI tools played a role in shifting the responsibility for reading from the teacher to the learners. But learners' autonomy was gained through the classroom support, rather than the technological tool itself, because they required lecturer's assistance and peer support and they had to repeat the reading process many times before achieving self-regulation. This confirms the Vygotsky's (1978) idea that any learning is mediated and social.

The contribution of adaptive learning was also relevant. ReadTheory seemed motivating for students because the system presents them with appropriately-difficult readings. An effortless text can lead to boredom,

whereas a text that is too challenging can lead to discouragement. Adaptive systems can maintain "desirable difficulty." This is also relevant in diverse classrooms because a given text will not be appropriate in difficulty level for all students. However, teachers must monitor adaptive pathways because progression on an adaptive platform does not necessarily translate into deeper text comprehension, critical reading, or transfer of skills to academic readings.

The use of tool feedback and generated questions supported formative assessment. Quillionz helped students consider text meaning and identify gaps in their understanding, and ReadTheory offered instant feedback on student responses to comprehension questions. This type of feedback promotes metacognition when students are asked to analyze why their answer is correct, to justify their answer with evidence, and to identify what strategy they should try next. Otherwise, feedback becomes only a score, whereas with the addition of student reflection, it becomes informative, ongoing assessment.

The role of the teacher was also illuminated. AI tools facilitated text analysis, reading practice, student support, and feedback; however, the instructor sequenced their use, explained the purpose of each tool, supervised student interaction with them, and helped them interpret what the data revealed. This addresses critics of AI in education for neglecting the role of the teacher (Zawacki-Richter et al., 2019). The instructor remained central in this intervention, and AI provided expanded instructional opportunities, but it did not displace the professional expertise of the instructor.

Equity concerns also must be considered. The reasonably uniform student usage of tools implies that carefully guided instruction can diminish access gaps. However, this equal participation cannot be taken for granted in every classroom. Students in remote areas, resource-scarce institutions, and/or under-connected classrooms will face greater obstacles. Students' use of AI tools in reading instruction requires careful attention to institutional support, such as the availability of devices, Internet, instruction in using digital technologies, and clear guidelines regarding how to use them ethically. Equity needs to be incorporated into the planning, not just as an afterthought.

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Finally, ethics. AI-powered educational tools can store, track and profile students. Holmes et al (2021) call for a human-centred approach to AI policy in education to protect students and preserve the authority of education. Here teachers would need to explain data use, resist over-automation in marking, and ensure students are aware of the capabilities (and restrictions) of AI output. Students should be pushed to challenge, cross-check, and modify their use of AI-generated explanation, rather than absorb it unquestioningly.

Interpreting the Learning Gains

The improvement observed in this study suggests that AI-assisted reading may help address several challenges commonly encountered by Indonesian EFL learners, including limited vocabulary knowledge, unequal exposure to English texts, and limited opportunities for individualized feedback. In the present study, Text Inspector, Rewordify, ReadTheory, and Quillionz provided different forms of support for identifying textual difficulty, clarifying vocabulary, practicing comprehension, and reviewing understanding. These tools may therefore have functioned as mediating resources that helped learners engage with texts that might otherwise have been difficult to process independently. This interpretation is consistent with Huong and Hung's (2021) discussion of digital tools as mediating resources in English language learning. The gains are also pedagogically significant because students with different proficiency levels could access different forms of assistance rather than depend on a single instructional pathway. Nevertheless, the findings should be interpreted as evidence of improvement within this instructional context rather than proof that all learners benefited equally.

The improvement should also be interpreted cautiously because the study did not include a control group. Consequently, it is not possible to attribute the observed gains exclusively to the AI tools. Other factors, including normal progress through the course, lecturer mediation, repeated reading practice, peer assistance, and increased motivation, may also have contributed. This limitation is important when interpreting intervention

outcomes because improvement following an instructional intervention does not, by itself, establish that the intervention caused the change. Lo et al. (2024), in their systematic review of empirical research on ChatGPT in ESL/EFL education, highlighted the diversity of research designs and the need for further empirical investigation across language-learning contexts. Similarly, Uygun and Demir (2026) emphasized that AI-supported language learning should be understood in relation to instructional design, implementation conditions, and contextual limitations. Therefore, a more balanced interpretation is that AI tools constituted enabling components of a broader learning ecology involving students, lecturers, peers, reading materials, pedagogical tasks, and digital resources. From a sociocultural perspective, learning is not located exclusively within a technological device; rather, it develops through the interaction between learners, mediational resources, and the instructional environment (Huong & Hung, 2021). The present findings consequently suggest the potential value of AI-supported reading as part of an integrated pedagogical arrangement, while leaving the independent contribution of each component unresolved.

The consistent use of the four tools also highlights the importance of establishing a clear pedagogical purpose for each technological resource. Text Inspector was used to examine text difficulty, Rewordify to support vocabulary and textual accessibility, ReadTheory to provide reading practice and comprehension feedback, and Quillionz to generate questions for reviewing textual understanding. This purposeful division of functions may have helped learners understand how each tool contributed to the reading process and reduced the likelihood of technology becoming a collection of disconnected activities. Mayer's (2024) cognitive theory of multimedia learning provides a useful perspective for interpreting this pattern. The theory emphasizes that meaningful learning requires learners to select relevant information, organize it into coherent mental representations, and integrate it with existing knowledge. Applied to the present study, the sequence of text analysis, vocabulary clarification, comprehension practice, and question-

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based review can be understood as an instructional structure intended to support these cognitive processes.

Overall, the findings support a pedagogical interpretation in which AI tools can facilitate access to reading materials and provide differentiated forms of support when embedded in a coherent instructional sequence. However, the absence of a control group means that the relative contributions of AI assistance, lecturer guidance, repeated practice, peer interaction, and other contextual factors cannot be separated. Future studies could use a control or comparison group, report effect sizes, and combine comprehension assessments with learner reflections and classroom observations to investigate the effectiveness of the integrated approach more rigorously.

Comparison with Prior Studies and Study Limitations

The magnitude of the comprehension gain observed in this study (M=61.2 to 80.1) converges with related AI-EFL research: Wei (2023) similarly found that AI-supported instruction was associated with improved English achievement with greater motivation and self-regulated learning, and Alazemi (2024) linked AI-based formative assessment to gains in reading proficiency and academic engagement. These parallels support the broader claim that AI use benefits EFL reading when properly mediated by a teacher.

At the same time, the findings diverge from parts of the wider literature in instructive ways. Kulkuska-Hulme and Lee (2020) caution that intelligent language learning assistants often show limited contextual accuracy and are rarely evaluated within an integrated classroom pedagogy; the comparatively strong and consistent gains found here suggest that combining four complementary tools within one teacher-mediated cycle can offset such limitations, so the result qualifies rather than contradicts their caution; the intervention's success appears to depend on pedagogical sequencing and teacher mediation rather than any single tool's technical accuracy. A sharper contradiction appears with Zawacki-Richter et. Al. (2019), who observed that AI applications in higher education tend to minimise the educator's role: in this intervention the opposite pattern held, since the lecturer remained central

to sequencing tool use, interpreting output, and providing feedback, which is a plausible reason the marginalisation Zawacki-Richter et al. describe did not occur here.

These comparisons should be read alongside several limitations, in addition to the absence of a control group noted above. The sample was a single, intact class of 28 students in one Indonesian faculty over one semester, so the findings cannot be generalised to other class sizes, disciplines, or regions without further testing. The quantitative analysis relied on aggregated class-level means rather than individual-level paired scores, which precluded inferential statistical testing and the identification of differential effects across proficiency levels. The qualitative data, although triangulated across journals, observations, and interviews, remain self-reported and observer-interpreted, and may be subject to social-desirability bias given that students were reporting on tools their own lecturer had introduced. Taken together, these limitations suggest that the findings are best read as evidence that a multi-tool, teacher-mediated AI reading cycle is a promising and theoretically coherent approach, rather than as proof of a generalizeable causal effect.

Theoretical Interpretation of the Findings

The results were consistent with the interactive model of reading, in that students' reading improvement seemed to rely on simultaneous interactions among processes rather than a single skill. Text Inspector and Rewordify facilitated bottom-up processing as they allowed students to notice the words, their frequencies and text complexity. ReadTheory and Quillionz facilitated top-down processing by promoting students' inferencing and monitoring skills and encouraging them to respond to questions after reading the texts. The interaction between both types of processes resembled the interactive view of reading that reading consists of simultaneous interaction between the lower level decoding processes and higher level processing for making sense (Grabe, 2009; Rumelhart, 1977).

The results were also explained by schema theory. Because they were able to preview vocabulary and contents before reading the difficult texts,

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students seemed better able to handle the texts. These pre-reading strategies facilitated prior knowledge activation and lowered cognitive demand. In the Indonesian EFL context where learners' background cultural, academic and subject-specific schema is often different from that assumed by the texts in English, previewing helps teachers identify the difficult sections which need teacher clarification before students read the texts on their own (Anderson & Pearson, 1984; Carrell & Eisterhold, 1983).

Vocabulary support also provided one of the core contributions of AI tools. Unknown words hinder students' fluency, increase the reliance on translation and prevent students from constructing holistic meanings. Rewordify alleviated such difficulties through offering students instant word support. This support was in line with Nation's (2013) position that vocabulary learning requires contextual and repeated exposures, however it must not replace students' active involvement. Therefore, teachers ought to direct students to note the words, their collocations, revise the new vocabulary across texts, and use them in their own sentences.

From the socio-cultural perspectives, these AI tools act as mediating tools which help students gradually shift from other-regulation to self-regulation. Initially they needed both the lecturer and their peers to guide them, later most of them became able to select the appropriate tools for their reading difficulties, which is compatible with Vygotsky's (1978) theory that learning develops through mediated actions. It is worth noticing that mediation was brought about not only by the digital tools, but the lecturer, peers, the task design and the digital feedbacks contributed together to mediate the process of learning.

Learner Autonomy and Metacognitive Development

An important finding of the study was the development of learner autonomy. More students reported feeling capable of approaching and tackling challenging English texts without immediately depending on the lecturer for explanations or translations. AI tools appeared to support this development by providing immediate access to vocabulary assistance, text

analysis, practice exercises, and feedback. However, the increased autonomy observed in this study is better understood as guided autonomy rather than complete independence. Learners developed greater responsibility for their reading while continuing to benefit from the lecturer's modeling, structured tasks, and guidance in using the tools purposefully. This interpretation is consistent with Zhao and Zhang (2026), who found that metacognitive strategies and critical thinking were associated with engagement in AI-assisted language learning. Their findings suggest that the educational value of AI depends not only on access to technological resources but also on learners' ability to regulate and critically evaluate their learning activities.

The intervention also appeared to encourage metacognitive reading behavior, particularly in planning, monitoring, and evaluating comprehension. When using Text Inspector, learners could anticipate potential vocabulary difficulties before engaging with a text. During ReadTheory exercises, they could examine their responses and consider feedback about their comprehension performance. Similarly, activities involving Quillionz encouraged learners to examine textual meaning when evaluating or responding to questions generated from reading materials. These activities provided opportunities for learners to recognize reading difficulties, monitor their understanding, and consider appropriate strategies for addressing comprehension problems. This interpretation aligns with Kan et al. (2024), whose systematic review identified the contribution of metacognitive reading strategies to English reading ability, particularly through problem-solving and strategic monitoring.

Pedagogical Implications for EFL Reading Instruction

Another important implication of the study is the need to integrate AI tools into a structured reading cycle rather than use them as independent, disconnected exercises. A possible sequence may involve text diagnosis, guided reading, vocabulary clarification, adaptive practice, comprehension assessment, and reflection. This approach provides students with a clear

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purpose for using each tool and connects technological activities with broader reading objectives. Research on AI-assisted language learning emphasizes the importance of aligning AI applications with educational theories and instructional objectives rather than adopting technology solely for its novelty or technical capabilities (Qiao et al., 2025). Similarly, research on computer-supported reading highlights the importance of providing appropriate cognitive and metacognitive scaffolding to support comprehension (ter Beek et al., 2018).

Teachers should also integrate AI-assisted activities with explicit reading strategy instruction. For example, after using Text Inspector to identify difficult vocabulary, students can predict the main topic and possible argument of a text. After using Rewordify, they can compare the original and simplified versions to identify changes in meaning, nuance, and textual complexity. Following ReadTheory quizzes, students should justify their answers with textual evidence. Similarly, after generating questions with Quillionz, students can evaluate whether the questions assess literal, inferential, or evaluative comprehension. These activities encourage students to use AI as a scaffold for comprehension and critical interpretation rather than as a substitute for independent reading. This recommendation is consistent with research emphasizing the contribution of metacognitive reading strategies to EFL learners' reading comprehension and reading behavior (Yulita & Napitupulu, 2023).

Both individual and collaborative activities should be incorporated into AI-supported reading instruction. Although digital reading tools can facilitate independent practice, comprehension activities can also benefit from opportunities to discuss interpretations, justify answers, and evaluate feedback collaboratively. Technology-enhanced collaborative language learning has been associated with benefits for language development and learners' affective experiences, supporting the inclusion of structured peer interaction alongside individual technology use (Su & Zou, 2022). In the present study, peer support also appeared to normalize technology use and

reduce anxiety among students who experienced difficulties learning to operate the tools. This finding suggests that collaborative activities may help develop digital confidence while maintaining the social dimension of reading.

Finally, teachers should interpret platform analytics cautiously. Scores, activity logs, and task duration may provide useful information about student participation and possible difficulties, but these indicators cannot independently establish the quality of learning or the depth of comprehension. Wilson et al. (2017) cautioned against treating digital traces as straightforward representations of learning. Similarly, Bergdahl et al. (2024) highlighted the complexity of interpreting student engagement through learning analytics. Therefore, platform-generated data should be triangulated with reading logs, classroom observations, comprehension assessments, and student reflections. A student who completes more tasks does not necessarily demonstrate better comprehension than one who completes fewer tasks but engages more deeply with challenging texts.

Implications for Teaching Practice

Several practical recommendations can be derived from the findings. First, EFL teachers should introduce AI tools as components of a coherent reading cycle rather than as ad hoc technological activities. A suitable sequence could include pre-reading assessment, guided reading, vocabulary support, comprehension checking, and reflection. Such an approach connects the use of technology with specific learning objectives and provides a pedagogical rationale for selecting each tool. This recommendation is consistent with Qiao et al. (2025), whose systematic review emphasizes the importance of instructional design and theoretically grounded implementation in AI-assisted language learning.

Second, teachers should provide explicit training in both technical skills and reading strategies. Students need demonstrations of how to interpret system feedback, select an appropriate tool for a particular reading difficulty, and evaluate simplified sentences or automatically generated answers critically. For example, students can use Text Inspector to examine

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the vocabulary demands of a text before reading and then formulate predictions about its content. Such preparation should be followed by actual engagement with the text to ensure that vocabulary assistance supports rather than replaces comprehension. Research on metacognitive reading strategies in EFL contexts supports the importance of teaching learners how to plan, monitor, and regulate their reading processes (Yulita & Napitupulu, 2023).

Third, reflection should be incorporated into AI-supported reading tasks. Students can maintain reading logs documenting the texts they read, the tools they used, the difficulties they encountered, the strategies they applied, and what they learned from the experience. These activities encourage metacognitive awareness and help teachers determine whether students use AI tools purposefully. Reflection also shifts students' attention from the novelty of the technology to the learning process itself. This recommendation is consistent with research on metacognitive reading strategies, which emphasizes the importance of learners' awareness and regulation of their reading behavior (Yulita & Napitupulu, 2023).

Fourth, teachers should combine individual and collaborative tasks. AI tools can facilitate independent reading practice, but structured peer interaction provides opportunities for students to compare interpretations, justify answers, and evaluate the quality of AI-generated questions. For example, students can discuss whether a simplified vocabulary item preserves the original meaning or whether a generated question requires inference rather than simple information retrieval. Such activities preserve the interpersonal dimension of language learning and are supported by research on technology-enhanced collaborative language learning (Su & Zou, 2022).

Fifth, teachers should use platform-generated evidence cautiously when evaluating student progress. System statistics can reveal interaction patterns, task completion, and possible areas of difficulty, but they should not be interpreted as direct measures of comprehension. Wilson et al. (2017) highlighted the limitations of using digital traces as proxies for learning, while Bergdahl et al. (2024) identified challenges in conceptualizing and measuring

student engagement through learning analytics. Accordingly, teachers should triangulate platform data with comprehension tests, classroom observations, reading logs, and student self-reports. A high frequency of activity may reflect repeated attempts or technical difficulties rather than deep learning, while a low score may indicate unfamiliarity with the platform as well as difficulties with the text. Professional judgment and multiple sources of evidence are therefore essential for responsible assessment.

CONCLUSION

This classroom-based study examined how four complementary AI tools-TextInspector, ReadTheory, Rewordify, and Quillionz-embedded in a teacher-mediated reading cycle affected EFL reading comprehension in an Indonesian university classroom. The main finding is that students' reading comprehension improved substantially (M = 61.2 to 80.1) alongside sustained engagement, growing confidence, more strategic reading behaviour, and greater autonomy, as evidenced by triangulated quantitative and qualitative data.

Theoretically, the study contributes evidence that interactive, schema, vocabulary-learning, sociocultural, and adaptive-learning perspectives can be jointly operationalised through a sequenced combination of AI tiils rather than through a single application. Practically, it contributes a replicable, teacher-mediated model-diagnosis, guided practice, vocabulary support, and review-that Indonesian EFL lecturers can adopt to address large classes, uneven learner readiness, and limited opportunities for individualised feedback, provided the teacher remains central to sequencing and interpreting tool use.

These conclusions are qualified by several limitations: the absence of a control group, the single class, single institution, one-semester scope of the study, reliance on aggregated rather than individual-level scores, and the self-reported nature of the qualitative data. The findings therefore indicate a promising, theoretically coherent approach rather than a generalizable causal effect.

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Future research should test this multi-tool reading cycle using quasi-experimental or experimental designs with control groups and individual-level pre/post data, extend it across multiple classes, institutions, and proficiency levels, examine its longer-term effects on reading and autonomy, and investigate how equitable access and ethical data use can be safeguarded as AI-supported reading instruction scales beyond a single classsroom.

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