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Original Article

Exploring the Role of AI Tools in Enhancing Metacognitive Strategies to Promote Self-Directed Reading among ESL Learners

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Abstract

This research investigates the effectiveness of utilizing artificial intelligence (AI) tools in planning, monitoring, and evaluating ESL students. This study aims to investigate the relationship between AI activities and the development of students' metacognitive processes. Thirty students participated in an AI-assisted reading program. The analysis was conducted using SPSS version 25 and included various tests. This research is significant for explaining ESL students' development and the impact of AI on them. The findings showed that while evaluation techniques were less commonly employed, learners regularly used AI technologies to assist with planning and monitoring. Pre- and post-test scores in reading comprehension improved significantly, and correlation analysis revealed a moderately favourable association between the frequency of AI use and the use of metacognitive strategies. These results suggest that although integrating AI can promote organized reading habits and scaffold understanding, it also risks diminishing students' capacity for autonomous reflection. The research concludes that AI can enhance self-directed reading through metacognitive engagement when implemented in a way that balances learner autonomy with technical assistance. Further research ought to focus on the long-term effects and pedagogical methods that can combine explicit training in reflective learning with AI assistance.

Keywords: Posthumanism; Haraway; Cyborg; Under the Currents; Pakistani science fiction

Introduction

Reading is an essential part of human socialization and cognitive development, transforming the reader's perception of the world and self. With the increasing adoption of AI technologies, including autonomous tutoring systems, conversational assistants, and large language models, new prospects for improving self-directed instruction have emerged for learners of English as a Second Language (ESL). According to a 2024 worldwide AI student poll, 86% of students use AI tools to help with their studies, underscoring the need to understand how these tools affect users' reading and cognition (Kelly, 2024).

Readers who want to succeed with digital texts need to know how to read in different digital formats (Hamid et al., 2020). Language learning methods are seen as tools that help students prepare for language activities, assess their learning, analyze word meanings, and apply what they have learned to improve their comprehension, recall, and use. To supervise, control, or guide self-directed language acquisition, metacognitive techniques are used. The capacity to make thoughtful choices about how to approach language acquisition successfully and a conscious awareness of one's own learning process are key components of these techniques (Varshney & Banerji, 2022). With an emphasis on gender, reading media choices, and English proficiency levels, the research of Anggia and Habok (2024) investigated consciousness in digital reading activities. To be a competent reader, one must be able to effectively regulate their reading process by using multiple methods before, throughout, and after reading the content (Chen et al., 2023), as Metacognitive strategies are one of the direct strategies that can be employed in acquiring knowledge of English, especially in reading comprehension.

Metacognitive strategies are used in organizing the overall learning process. They include many stages, from the preparation of learning, such as identification of an individual's own learning style preferences and needs, planning for an L2 task, gathering and organizing materials, and arranging a study space and a schedule, while learning, such as monitoring mistakes, as well as the evaluation phase, such as evaluating task success and evaluating the success of any learning strategy. Hence, a study is conducted to investigate the metacognitive strategies ESL learners in secondary schools employ to comprehend academic texts. Well, as we interact with the text for interaction, meaning-making, and problem-solving.

Strategies are particularly crucial for language acquisition because they serve as tools for self-directed, active engagement, which is necessary to build communicative competence. The goal of Global Reading Strategies (GLOB) was to prepare readers for reading. The strategies include reading with an outcome in mind, considering prior knowledge to help the reader comprehend what is read, assessing whether the text's content aligns with the reading goal, and first examining the text by noting its length and structure. More methods include the reader's ability to choose what to pay close attention to and what to ignore while reading, the use of tables, figures, and images to enhance comprehension, the use of context clues to aid in comprehension, and the use of typographic elements like bold font and italics to highlight important details—compared with students who don't use AI analytics software, those who do often report higher motivation, improved critical thinking skills, and better academic performance (Zhang et al., 2022). Students can reflect on the reading assignments and improve their learning by responding to reading questions independently, with the help of AI tutors. As a result, kids may continue to oversee their own reading education and develop productive methods of understanding how they learn.

AI is currently used in education to assist in creating assessments tailored to each student's unique needs by being adaptable and constantly ready to adjust to their reading. AI-powered technologies may analyze a person's reading abilities, problems, and interests to assist instructors and students, something that traditional teaching methods might not take into account. With this level of personalization, AI enables students

to actively participate in their reading courses based on what best suits their mentalities, which improves learning outcomes. High school pupils benefit from AI's individualized learning approach, which boosts their confidence, improves their reading comprehension, and focuses on their strengths. Using AI in education helps by supplying students with instant feedback that increases their understanding of their own reading processes. They get students to think more deeply about their reading, which leads them to make more effective study schedules and to monitor their reading development consistently.

Similarly, artificial intelligence programs in language instruction have increased understanding by promoting self-regulated learning practices (Shafiee Rad et al., 2025). However, researchers believe that AI technologies might promote "metacognitive laziness," in which students rely too heavily on assistance and fail to develop reflective abilities (Fan et al., 2024). Self-regulatory readers frequently establish attainable objectives, use efficient reading techniques to fully understand the material, regularly assess their comprehension of the text, or monitor their progress toward their objectives (Sashikala & Chye, 2023).

The SRL model is divided into three stages: performance (where students carry out tasks, track their progress, and use self-control techniques to stay motivated and focused), self-reflection (where they evaluate performance, assign success or failure, and modify strategies for subsequent tasks), and forethought (where students analyze tasks, set goals, and formulate methods, motivated by motivational beliefs) (Zimmerman, 2002). Effective learning in SRL requires metacognitive techniques such as goal setting, self-monitoring, and self-evaluation (Zimmerman, 2008). However, a variety of obstacles face students when they work to regulate their behavior, including low achievement motivation, task complexity, and insufficient metacognitive strategies (de Bruin et al., 2023; Russell et al., 2022; Wild and Grassinger, 2023).

Even though AI-assisted learning is becoming more popular, little research has examined how AI specifically helps ESL students with metacognitive reading methods, including planning, monitoring, and assessment. Research from 2024 and 2025 shows both practical disadvantages (such as overreliance on AI and decreased self-regulation) and advantages (such as enhanced engagement and strategy use) (Chen et al., 2024; Fan et al., 2024; Shafiee Rad et al., 2025).

Because digital online training is flexible, adaptable, and accessible at any time and from any location, it may be used to solve such issues (Broadbent & Poon, 2015). Furthermore, while the study of online reading methods in ESL environments is growing (Abdullah & Ismail, 2025), most investigations do not focus on the impact of artificial intelligence on the development of self-directed reading habits. This remains an open question of whether AI technologies are true boosters of autonomy or replacements that undermine reflective practice. Therefore, this study aims to explore the role of AI tools in enhancing metacognitive strategies to Promote Self-Directed Reading.

Research Questions

Q1. To what extent do AI tools assist ESL students in more effectively developing and improving their metacognitive strategies, including planning, monitoring, and evaluation, as they read independently?

Q2. What is the connection between ESL learners' use of AI tools and their application of metacognitive strategies?

Literature Review

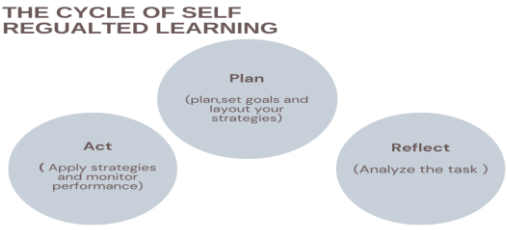
The acquisition and improvement of advanced abilities, including reading proficiency, typically require direct instruction, constructive feedback, and sustained practice over an extended period (Serrano-Mendizabal et al., 2023). With features such as goal setting, immediate feedback, and progress tracking, AI systems for language learners have been developed to improve planning, tracking, and participation (Shafiee Rad et al., 2025). AI programs like ChatGPT, Rewordify, and Read Theory that provide personalized and interactive instructional experiences are beginning to show promise as solutions to these issues (Khan & Rasheed, 2022; Noor & Hussain, 2024).

Although AI has demonstrated that it can enhance reading comprehension, further studies are needed to fully explore the potential benefits of AI-mediated applications, particularly their ability to increase student motivation and self-directed learning (Srinivasan and Murthy, 2021). The study by Chen et al. (2024) stated that students who use generative AI chatbots gain a better understanding of and interest in learning tasks as they receive interactive suggestions that encourage them to monitor themselves and reflect.

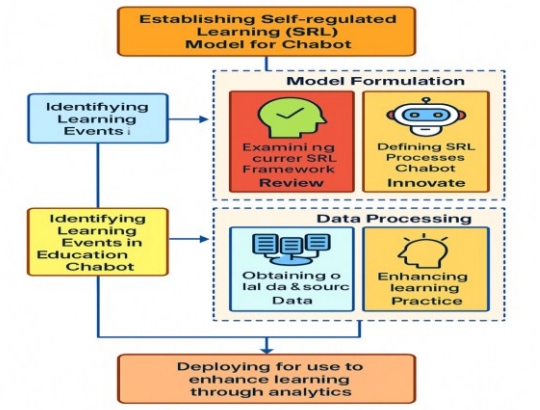
According to Ng et al. (2021), AI literacy should be viewed not only as a technical skill but also as an ethical application, critical thinking, and understanding of the biases and limitations involved in AI systems. In this way, for ESL students, AI literacy enhances language learning by providing access to feedback within seconds, personalized training, and exposure to language input and output (Kasneci et al., 2023). In the study conducted by Dira and Kuswandono (2025) on EFL master's students in Indonesia, the authors found that AI tools such as ChatGPT and Google Gemini provided students with individualized learning opportunities, self-evaluation opportunities, and meaningful feedback, thereby enhancing critical thinking and metacognitive awareness.

Theoretical Framework

This study explains Self-Regulation of Learning (SRL) through the concepts of Zimmerman (2002), which describes how students actively manage their learning under the influence of preparation, observation, and assessment. In these times, every student should focus on the clarity of their goals rather than superficially accept information. They consider the outcomes of their education and work to deepen their comprehension rather than disregarding their own development. Cognitive experience is critical for ESL learners who struggle with independent study, text comprehension, and vocabulary organization.



An essential component of the evolution of artificial intelligence is self-regulated learning. It highlights how digital technology can help students organize their learning activities, deepen their understanding, and track their progress. AI apps, which include tailored dashboards and quick feedback, help students stay focused on their studies. In addition, AI can make cognitive processes more observable and manageable, which is consistent with the stages of self-regulated learning.



Learners must take command of their reading assignments and prepare for the level of autonomy they can require as they pursue their education and careers. Metacognitive instruction enables children to control their reading, stay motivated, and respond to school pressure. Self-questioning, reviewing key reading concepts, writing in a notebook, and using graphic organizers are all approaches that help students track their reading development and learn more efficiently. Instead of passively using AI, effective learners evaluate results critically, cross-reference sources, and adjust their language use as necessary (Roe et al., 2023).

This study used metacognitive strategies, such as monitoring and evaluation, as a central lens to assess the role of AI tools. It draws on Self-Regulated Learning (SRL) theory to provide a systematic way to explore how the use of AI can help or hinder ESL learners in becoming independent, reflective, and self-directed readers. Students with high reading and metacognitive abilities may participate in group discussions, articulate their reading ideas rationally, and offer constructive criticism to their classmates, according to Dignath & Veenman (2021). When students work together, they may identify reading themes that baffle them, offer appropriate solutions to reading challenges, and help the group evaluate what went well in their reading lessons. Such reading practices in social learning boost students' success while rendering communal reading studies and classroom reading learning more effective.

Research Methodology

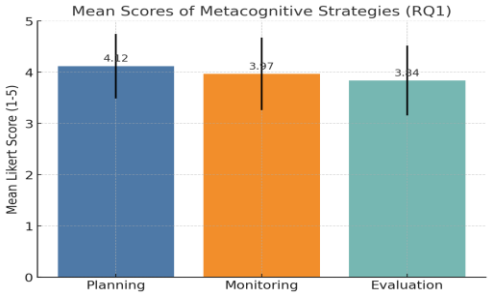
The study adopted a specific approach to investigate how AI tools support ESL learners in self-directed reading, particularly through metacognitive strategies such as planning, monitoring, and evaluation. A survey method was used to collect data for statistical analysis. Two hundred undergraduate ESL students from the University of Sanghar in Pakistan were included in the sample; they were chosen using a convenience sampling method. Twenty of these students were selected to take pre- and post-tests to determine how their use of strategies changed while reading with AI help.

Pre- and post-reading comprehension exercises (vocabulary, inference, comprehension) were given following a two-week AI-supported reading intervention using tools such as ChatGPT, translation apps, and summarizers. Additionally, a 14-item Likert-based questionnaire measuring AI tool usage, metacognitive strategies, and autonomy among learners was used to gather data.

The data were analyzed using SPSS Version 25. The responses to the questionnaires were analyzed using descriptive statistics; reliability was estimated using Cronbach's alpha; the pre- and post-test scores were compared using paired-sample t-tests; and the correlation between the use of AI tools and the implementation of metacognitive strategies was explored using correlation analysis. Volunteer participation and the freedom to cancel without penalty ensured compliance with the ethical standards by assuring anonymity.

Research Finding

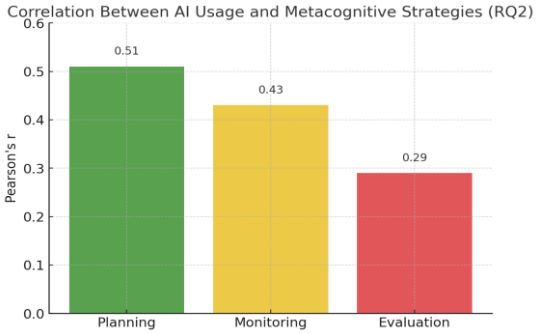
Q1. To what extent do AI tools assist ESL students in more effectively developing and improving their metacognitive strategies, including planning, monitoring, and evaluation, as they read independently?



This graph illustrates how students used AI technologies for various metacognitive techniques. Planning had the highest mean (M = 4.12), followed by evaluation (M = 3.84) and monitoring (M = 3.97). Standard deviations are represented by the error bars, which indicate some variation in the techniques used, but consistently demonstrate that planning received higher scores.

This suggests that learners primarily used AI for goal setting, text selection, and recognizing challenging language in the early reading phases. Monitoring was also typical, including the use of artificial intelligence highlights or translations to assess understanding. Evaluation, on the other hand, which reflects on the long-term utility of AI, was less emphasized. The advances on the pre- and post-tests provided additional evidence that these tactics, especially planning and monitoring, supported notable changes in reading comprehension.

Q2. What is the connection between ESL learners' use of AI tools and their application of metacognitive strategies?



The relationship between each technique and AI usage is seen in the graph. The largest association (r = .51) is shown in planning, followed by monitoring (r = .43) and assessment (r = .29), which is lower but still positive.

This shows that students who used AI tools more often were particularly likely to apply planning and monitoring tactics. Put another way, students grew more methodical in their planning and handling of reading assignments whenever they relied on AI. The fact that the analysis was essentially unaffected by AI suggests that learner autonomy remains a more significant factor in critical thinking and the assessment of AI's effectiveness.

Discussion

The research results indicate that AI technologies play a key role in enhancing ESL students' metacognitive strategies during autonomous reading. According to Gavin-Chocano et al. (2024), AI systems can be effective in helping with introspection and setting goals, yet ethical considerations and proper design determine their effectiveness. AI-based teaching tactics help learners strengthen their mental processes and self-regulation skills (Panadero et al., 2024). Self-regulation is a complex process that involves many cognitive, motivational, and learning mechanisms. Self-regulated pupils direct their own learning process and assess their learning outcomes. In terms of accountability, they accept responsibility for their individual learning. Successful self-regulated learners become aware of numerous learning techniques and employ them successfully.

First, the findings show that learners often use AI for tasks such as planning and monitoring, which can help set goals, clarify vocabulary, and check comprehension. However, assessment was used less consistently. It is also clear that when students had access to an AI assistant, they were less confident in their use of it for reflective judgment. These findings are consistent with prior work that digital tools strengthen immediate comprehension but do not always promote deeper self-evaluation. Three stages of Zimmerman's Cyclical model of self-regulation performance, self-reflection, and planning may promote evaluation as a process.

On the other hand, the pre- and post-test results of the intervention group showed a clear increase in reading after two weeks of AI-assisted practice. Learners showed an increase in word recognition, inference, and text comprehension. This is beneficial for the active learning efficacy of AI and helps to strengthen reading outcomes. Literacy helps ESL learners acquire the language by providing them with more opportunities for tailored learning, instant feedback, and exposure to real input and output (Kasneci et al., 2023). These results show both possibilities and difficulties. AI has the potential to be a useful scaffold, especially for students who have trouble understanding and using language. Conversely, an excessive dependence may hinder the growth of self-regulating abilities. Thus, educators should promote balanced use of AI technologies as aids while encouraging learners to assess their own development.

The use of metacognitive techniques and frequent AI use were found to be significantly and positively correlated in the correlation analysis. Full-time AI users tend to employ better techniques and arrange their studies more methodically and regularly. But caution should also be used when interpreting this research. These findings support Y. Chen et al. (2024) recommendation that research on the application of AI for learning be conducted across cultural boundaries to verify its applicability and adaptability. This material takes into account the need for evolving content, in which AI is supported, but human learners remain important in decision-making and reflection. They need to work proactively to maintain balance.

It showed that students' varied, recurring, evaluative, and reflective interactions with AI tools were the source of their metacognitive knowledge about AI applications, including when, where, and how to employ which AI tool.ESL learners' cognitive techniques are greatly enhanced by artificial intelligence, which promotes greater confidence and independent learning by improving planning, self-monitoring, and overall language acquisition. Clear direction with a focus on reflection is necessary for effective technology integration. AI technologies ought to improve self-regulation, helping students become more self-reliant, organized, and self-assured. Students may establish a stimulating educational environment that encourages critical thinking, personal growth, and lifelong skills required for success in the digital age by promoting the intelligent use of technology.

Conclusion

This study highlights how AI may enhance ESL learners' metacognitive participation in self-directed reading, particularly in scheduling and tracking. The findings suggest that integrating AI might lead to more organized reading habits and improved comprehension. To guarantee that students continue to be engaged, introspective, and self-directed, however, consistent focus must be placed on improving assessment abilities.

Future studies should examine instructional approaches that integrate technology assistance with specific training in metacognitive reflection, as well as the long-term impacts of AI-assisted reading. By doing this, researchers and educators can optimize AI's benefits while fostering the development of self-sufficient, autonomous learners.

The results also emphasize the importance of striking a balance between learner autonomy and technology dependence. Both critical thinking and reflection processes, necessary for continuous education, should not be replaced by AI technologies, even though AI can support understanding and the use of strategy. To ensure that students use these technologies simply as a support system rather than as a replacement for self-regulation, educators and curriculum developers are urged to use AI in ways that foster eventual independence.

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Credit authorship contribution statement

Syed Hyder Raza Shah: Writing –review & editing, Writing – original draft, Methodology, Formal analysis.

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