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Research Article:

Exploring Students' Purpose and Metacognitive Strategies in Utilising Artificial Intelligence for Language Learning

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ABSTRACT

Artificial Intelligence (AI) has become commonplace and is increasingly integrated into our daily lives, particularly among students who use AI applications for various purposes. However, the integration of this technology has raised concerns about its appropriate use and pedagogical implications. This study aimed to identify the purposes for which students utilise AI and to examine their use of metacognitive strategies when using AI in language learning. A total of 241 undergraduate English Language students from a local Malaysian university participated in the study. Data were collected via a survey adapted from the Online Survey of Reading Strategies (OSORS). The findings revealed that the main purpose for using AI was to complete assignments, such as writing and translation tasks. The primary reading strategies employed were Problem Solving metacognitive strategies, while Global and Support metacognitive strategies were used least. These results highlight the necessity for student-led information evaluation and self-regulation when navigating AI in academic contexts. Students need to be made aware of the importance of applying metacognitive strategies in their daily activities. For educators, there is a need to revisit assessments and educational support systems to account for the use of AI.

Keywords: Artificial Intelligence (AI), educational support systems, metacognitive strategies, online language learning

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INTRODUCTION

Artificial Intelligence (AI) has been integrated into our lives, often so seamlessly that it goes unnoticed. AI is defined as a transformative technology capable of simulating or mimicking human intelligence (IBM, 2024; Russell & Norvig, 2020). In 2017, it was speculated that by the 2020s, AI would be seamlessly incorporated into modern life (Kite-Powell, 2017). As AI permeates almost every aspect of our lives, concerns have arisen about the extent to which AI should be utilised in academia. There is a valid concern that students may become overly reliant on AI and, without it, may be less productive (Zhai et al., 2024).

AI has demonstrated considerable utility in the language learning classroom. AI applications such as Siri and Alexa help answer questions and pronounce words in English. Users can engage in oral interactions with these applications. AI corrective tools like Grammarly and Quillbot have been found to be the most popular for learning writing skills (Roe et al., 2023; Woo & Choi, 2021). Other commonly used AI tools in language learning include ChatGPT and Perplexity. These tools help students and researchers source information on any given topic and enhance their writing output. However, questions remain regarding the use of AI for reading skills. AI such as Perplexity, for example, can "read" for users to find and synthesise information from various articles. Are students able to simulate the same process without AI? Students need to become acquainted with potential societal biases, critical issues, and risks associated with AI (Roe et al., 2023; Selelo, 2023). Reading is an interactive cognitive process. To read effectively, one must employ several reading strategies simultaneously. Moreover, the ability to self-regulate and monitor one's own reading ensures deeper comprehension (Flavell, 1979; O'Malley & Chamot, 1990). Abundant research has been conducted on online reading and metacognitive strategies; however, with the surge of AI in the academic world, the reading process in language learning should be revisited (Anderson, 2002; Ahmadian & Pasand, 2017; Azizah Rajab et al., 2017; Darwish, 2017; Jusoh & Abdullah, 2015; Mohd Ramli, 2021; Ramli et al., 2011; Rianto, 2022; Roe et al., 2023).

This study seeks to answer the following questions:

1. What is the purpose of using AI among these language learners?
2. What are the main (top 10) metacognitive reading strategies used while reading responses from AI?
3. What are the least (bottom 5) metacognitive reading strategies used while reading responses from AI?
4. Is there a significant difference among the metacognitive reading strategies (Global, Problem Solving and Support) used while reading responses from AI?

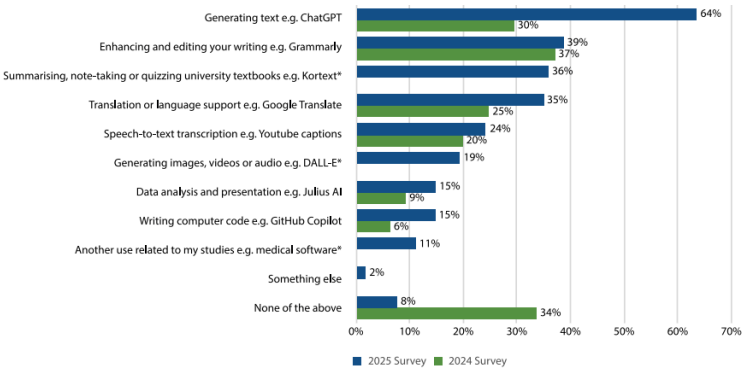
REVIEW OF RELATED LITERATURE

AI in Language Learning

AI has clearly become pivotal in language teaching and learning due to its various benefits. In 2016, Stanford University released the "100-Year Report on AI", which investigated eight factors related to AI, including education. The report stated that AI showed great promise for language learning, as it has the capability to personalise learning and mimic natural language acquisition (Stone et al., 2022). A review of types of AI tools for language learning and teaching by Woo and Choi (2021) reported that speaking and listening skills are the most developed areas in AI. Speaking can be improved with the assistance of AI. Through personalised practice, language students are exposed to an unlimited repertoire of simulated interactive sessions. Among popular natural language processing AI used for practising speaking are Siri and Alexa. Chatbots, as AI conversational partners, were found to be limited in terms of the conversation context between learners and AI; however, learners perceived the technology positively with proper guidance from the teacher (Belda-Medina & Calvo-Ferrer, 2022). Corrective tools such as Grammarly and Quillbot were found to be the most popular for learning writing skills (Woo & Choi, 2021). Other generative AIs, such as ChatGPT and Perplexity, help students and researchers source information on any given topic and enhance their writing output. Annamalai et al. (2025) advocate that ChatGPT has become an essential tool in motivating English as a Second Language (ESL) students; however, developers need to incorporate more humanised experiences into AI. The most common uses of generative AI are to explain concepts, summarise articles, and suggest research ideas.

According to Freeman (2025), the undergraduate landscape has seen a significant increase in generative AI integration. Within one year, the proportion of students using platforms such as ChatGPT and Microsoft CoPilot rose from 53% to 88%, highlighting the rapid ubiquity of these technologies in higher education. Generative AI is popular among students because it provides instant feedback, assists with text generation, and supports various academic tasks such as writing, summarising, and researching information (Figure 1). Its accessibility and user-friendly interface also make it a convenient learning tool that helps students manage academic demands more efficiently.

Another motivating, generative, and assistive AI-powered reading progress tool is Microsoft Reading Coach. It promotes English as a Foreign Language (EFL) students' oral reading and pronunciation skills (Jose, 2025). By reading stories, the Reading Coach analyses EFL learners' reading fluency and provides feedback accordingly. Similarly, it is recommended that EFL instructors strategically integrate AI tools in the classroom to enhance reading proficiency and motivation (Daweli & Mahyoub, 2024).



Note: Taken from Student Generative AI Survey 2025 by Freeman (2025). It depicts the range of AI use among students.

Figure 1. What have you used AI for?

The use of AI is not limited to language learning. In psycholinguistics, AI can analyse natural language processes in humans (Ali, 2020). Researchers have found that AI platforms enable the identification of linguistic coping strategies. AI has evolved significantly in language learning, with ongoing improvements. Ali (2020) and Selelo (2023) suggested that a clear strategy within educational support systems and a clear pedagogical approach, with a strong focus on critical thinking and fact-checking strategies, are required. This is necessary to fully utilise large language models in learning environments and teaching curricula.

Reading Process

The reading process largely depends on the reader's prior knowledge, which is constructed through their perception of the world (Carrell et al., 1988; Nuttall, 1996). Thus, comprehension of a text is achieved when the information perceived in the text connects with the reader's prior or background knowledge (Bernhardt, 1991; Nuttall, 1996). This process is an intrapersonal problem-solving task in which the reader processes the text and interprets the data received within their mental structures (Bernhardt, 1991). Effective reading requires the reader to interpret or decode the message or purpose of the text presented (Nuttall, 1996). The writer's intended meaning should be interpreted by the reader for comprehension to be achieved. With online reading, readers engage with multiple digital platforms that enable them to enjoy reading (Liman Kaban & Karadeniz, 2021; Singer & Alexander, 2016; Tazijan, Aboo Bakar, et al., 2019; Tazijan, Mohd Ramli. et al., 2022). Therefore, the ability to read effectively requires effort from the reader to make mental connections between the text or online text and their existing knowledge, with the assistance of available reading tools.

From the socio-constructivist perspective, a person's learning is shaped through interactions with the people and environment around them (Vygotsky, 1997). Vygotsky's sociocultural theory introduced scaffolding, which refers to the temporary support provided by a teacher or more knowledgeable peer to help learners accomplish tasks they cannot yet complete independently. As learners gain competence, this support is gradually reduced, enabling them to perform the task independently. Therefore, in reading, a learner will need support or scaffolding before they can fully understand a text. Technology has always proved to be able to assist learners providing them assistance, support or and scaffolding that eventually expand what termed by Vygotsky as the Zone of Proximal Development (ZPD), which refers to the gap between what a learner can do alone and what they can achieve with help from a more knowledgeable person, such as a teacher or peer as illustrated in Figure 2.

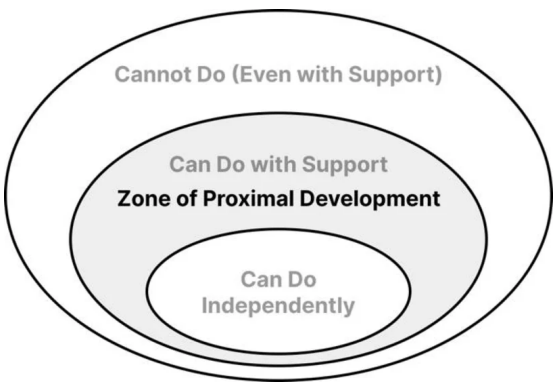


Figure 2. Vygotsky's Zone of Proximal Development (ZPD)

Metacognitive Strategies

According to Flavell (1979), metacognitive strategies are tools that enable students to monitor and control their learning. The function of this cognitive strategy is to supervise or monitor other cognitive strategies, making it a higher-order cognitive competence. In simple terms, these are "thinking about thinking" processes that help students plan their learning, check their understanding, and evaluate their progress. Research on metacognitive skills has begun to be conducted in relation to language learning (Azmuddin et al., 2017; Ahmadian & Pasand, 2017; Darwish, 2017; Jusoh & Abdullah, 2015; Azizah Rajab et al., 2017; Ramli et al., 2011; Rianto, 2022). O'Malley and Chamot (1990, p. 44) define metacognitive techniques as "higher order executive skills that may entail planning for, monitoring, or evaluating the success of learning activities. Moreover, metacognitive abilities are particularly important in ESL learning. The ability to distinguish between effective and ineffective learning strategies has proved advantageous for ESL students. Krashen (1987; 1988) also argues that the capacity to modify language output in a communicative context is essential to ESL learning. An ESL learner's ability to track or modify their own learning process has a significant impact on their achievement.

Effective reading is one of the most important skills that teachers can help ESL learners develop, as it is fundamental to language learning success, as noted by Anderson (2002; 2012). The ability to monitor and adapt one's reading skills during a reading task is the determining factor for successful reading and, ultimately, learning. Zápotočná (2016) argues that new literacy or knowledge gained, whether through reading online or offline, involves the same information processing, as it is a cognitive process for acquiring new information. Therefore, metacognitive strategies are especially prevalent and crucial during the information search phase, when readers are more focused on finding various information sources (Zápotočná, 2016).

Researchers such as Anderson (2002) and Mokhtari and Sheorey (2002) emphasise the use of metacognitive skills in ESL reading. Further research on ESL metacognitive skills indicates that fostering awareness and providing training in metacognitive strategies are integral aspects of ESL reading classrooms (Mokhtari & Reichard, 2002). Accordingly, this study is based on Mokhtari and Sheorey's (2002) categorisation of metacognitive strategies, which are as follows:

1. Global strategies: Readers plan their reading by using techniques such as setting a purpose in mind while reading text.
2. Problem Solving strategies: Readers work directly with the text to solve problems while reading, such as rereading text and adjusting the speed of reading.
3. Support strategies: Readers use basic support mechanisms to aid reading, like referring to a dictionary, filling in tables, summarising, and taking notes.

The three categories become the main categories of their survey, Survey of Reading Strategies (SORS).

Anderson (2002), on the other hand, classifies the metacognitive reading strategies of ESL learners into five primary components. The first component is preparing and planning for effective reading. Next, learners need to decide when to use particular reading strategies. This is followed by knowing how to monitor reading strategy use and learning how to orchestrate various reading strategies. Finally, learners must constantly evaluate their reading strategies. This cognitive process encourages critical thinking. Anderson (2003) adapted these strategies and highlighted their importance in online reading instruction. Figure 3 identifies the five key metacognitive strategies that interacts during reading process.

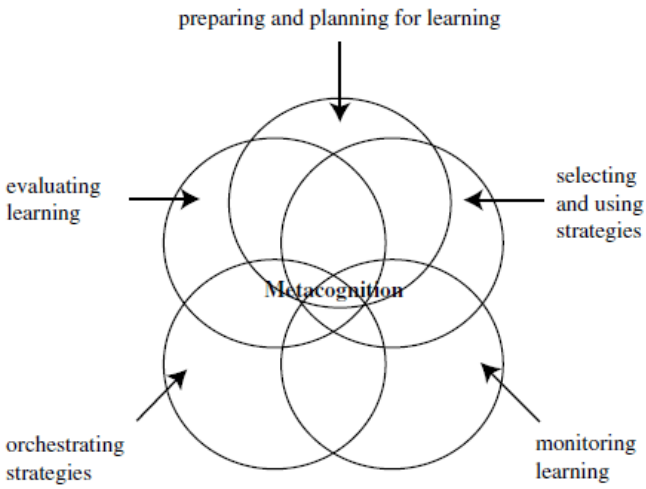


Figure 3. A model of metacognition (Anderson, 2008)

Anderson (2003) developed the Online Survey of Reading Strategies (OSORS) based on this model. OSORS consists of 38 items namely 18 Global strategies, 11 Problem Solving strategies and 9 Support strategies. Anderson (2003) found that both EFL and ESL learners mainly used Problem Solving strategies when reading academic material online. He highlighted the importance of strategy instruction and the potential differences in learning environments of L2 learners, especially when the learners are engaged in online reading. In a subsequent study, Ramli et al. (2011) found that adult ESL learners at a local university predominantly employed global strategies when engaging in online reading. This finding suggests that age may be a contributing factor influencing the preference for certain metacognitive strategies over others. It is possible that adult learners, due to greater cognitive maturity and learning experience, are more inclined to utilise higher-order strategies such as planning, monitoring, and evaluating, which are characteristic of global strategy use. Jusoh and Abdullah (2015) conducted a survey to investigate whether there were differences in the use of strategies between students in different fields of study. The findings suggest that the field of study has no impact on the overall strategies preferred. Azmuddin et al. (2017) adapted OSORS to gauge metacognitive strategies among Science and Technology students and found that Problem Solving strategies were the most used, followed by Global and Support reading strategies. Darwish (2017) reported that among Lebanese EFL university students reading English texts online, learners reported low to moderate strategy use. Hamid et al. (2020) found that the Problem Solving strategy was the most used among pre-university students. It involves the use of specific techniques when readers encounter problems while reading online. Using OSORS, Rianto (2022) found that before the pandemic, Support strategies were used more frequently, while global strategies were used less frequently. During the pandemic, Support and Problem Solving

strategies were more dominantly used, while Global strategies remained the least used. The different strategies used by different groups of students and under different conditions show that there is a need to raise students' awareness of the importance of varied strategy use when reading materials online. From these studies, it can be concluded that strategy training can help students become more autonomous.

A comprehensive search of relevant literature was conducted using the Scopus database for articles published between 2018 and 2025. The search terms used included "artificial intelligence", "chatbot", "adaptive learning", "large language model", "metacognition", and "self-regulated learning". Initially, 316 articles were identified for potential relevance. After screening for relevance, duplication, and quality of research methods, 24 articles were found to be relevant for this study. The evidence from the articles shows that AI-based learning platforms, such as "ChatGPT", significantly improve students' metacognition skills and learning outcomes in various fields of study. Most of the articles used mixed methods and experimental designs in which generative AI was integrated into structured models of teaching and learning, such as self-regulated learning and metacognition awareness models and taxonomies. Studies by Abdelhalim (2024), Han et al. (2025), Teng (2025), and Yang et al. (2025) confirmed that metacognition awareness is crucial for effective AI integration in EFL writing classes. Moreover, students with high metacognition awareness skills tend to use AI for metacognition and adaptive learning (Wang et al., 2025; Jin et al., 2025; Weng et al., 2024).

In addition, lower levels of awareness also increase students' reliance on AI. Systematic reviews by Ba et al. (2025) and Sharma et al. (2024) corroborate findings on how AI feedback and adaptive environments facilitate learner-centered regulation. Significantly, Urban et al. (2025) also indicate that metacognitive accuracy helps mitigate students' misuse of AI-generated misinformation. It is, therefore, possible to mitigate and manage ethical issues related to AI use in students' tasks and assignments. Moreover, AI also has a positive effect on students' learning outcomes through structured reflection (Al-Fattal, 2025) and gamification (Al-Rousan et al., 2025), leading to improved students' motivation, flow, and self-efficacy. However, some potential risks of students' over-reliance and cognitive under-effort also emanate from the literature (Hwang et al., 2025; Wang et al., 2025), emphasising the need for scaffolding and ethical AI literacy (Anders & Speltz, 2025). In essence, AI-assisted learning platforms are also effective in facilitating students' learning and metacognition through metacognitive models that emphasise reflection, learner regulation, and feedback. Rashid (2025) indicates that EFL students' metacognitive knowledge is influenced by their habitual use of AI, especially when combined with traditional methodologies.

In addition, scholarly analyses suggest that EFL experts, academia, and policymakers should incorporate artificial intelligence into EFL learning strategically, backed by awareness of its potential benefits and risks. The synthesis, therefore, shows that artificial intelligence has a positive but conditional influence on learners' metacognitive abilities and learning achievements, as it is most effective when it supports, rather than replaces, human cognition. The application of metacognitive strategies, on one hand, confirms learners'

ability to regulate and manage their own learning processes. The application of artificial intelligence, on the other hand, may seem to undermine learners' cognitive involvement. Nevertheless, modern learners have begun to employ metacognitive strategies to interact more successfully with artificial intelligence. This is a paradigm shift in EFL pedagogy, where learners need to be strategically and self-reflectively aware of artificial intelligence's support, rather than replacement, of human cognition.

METHOD

This study used an explanatory mixed method approach to address the research questions. This allowed data to be collected from a large sample, enabling generalisation and statistical analysis (Creswell & Creswell, 2018). The study was conducted at a local university in Shah Alam, Malaysia, involving 241 learners enrolled in a language programme.

Research Design

The design of this research is based on Creswell's "Explanatory Sequential Design" (or Explanatory Mixed Methods) Creswell (2012). In this design, the data collection starts with the collection of quantitative data followed by its analysis. The third step is the qualitative data collection followed by analysis and eventually the overall interpretation of data. The qualitative data were employed to complement and provide deeper explanatory insights into the quantitative findings, consistent with an explanatory sequential mixed methods approach. The whole process is simplified in Figure 4.

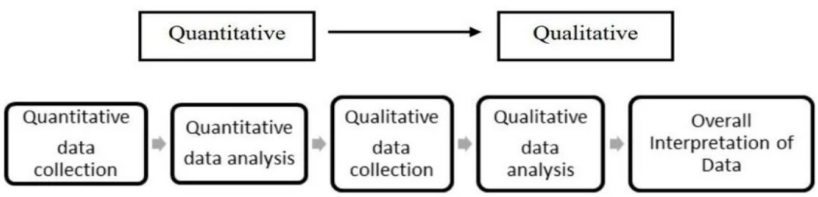


Figure 4. Explanatory sequential design (Adopted from Creswell, 2012)

Research Instrument

The main research instrument is a survey. This survey describes the ESL learners' purposes for using AI and their metacognitive online reading strategies while using AI. For Research Question 1, the survey listed five common purposes of using AI (entertainment, creative writing, assignments, editing/proofreading, and translating) and an open-ended question for the respondents to add their own purposes of using AI. To answer Research Questions 2, 3 and 4, this study adapted Anderson's (2003) OSORS, which categorises respondents' metacognitive strategies into Global strategies (18 items) (Table 1), Problem Solving strategies (11 items) (Table 2), and Support strategies (9 items) (Table 3).

Table 1. Items under Global strategy

No.	Item
1	I have a purpose in mind when I read online.
2	I participate in live chat with other learners of English.
3	I participate in live chat with native speakers of English.
4	I think about what I know to help me understand what I read online.
5	I take an overall view of the online text to see what it is about before reading it.
6	I think about whether the content of the online text fits my reading purpose.
7	I review the online text first by noting its characteristics like length and organisation.
8	When reading online, I decide what to read closely and what to ignore.
9	I read pages on the Internet for academic purposes.
10	I use tables, figures, and pictures in the online text to increase my understanding.
11	I use context clues to help me better understand what I am reading online.
12	I use typographical features like bold face and italics to identify key information.
13	I critically analyse and evaluate the information presented in the online text.
14	I check my understanding when I come across new information.
15	I try to guess what the content of the online text is about when I read.
16	I check to see if my guesses about the online text are right or wrong.
17	I scan the online text to get a basic idea of whether it will serve my purposes before choosing to read it.
18	I read pages on the Internet for fun.

Table 2. Items under Problem Solving strategy

No.	Item
1	I read slowly and carefully to make sure I understand what I am reading online.
2	I try to get back on track when I lose concentration.
3	I adjust my reading speed according to what I am reading online.
4	When online text becomes difficult, I pay closer attention to what I am reading.
5	I stop from time to time and think about what I am reading online.
6	I try to picture or visualise information to help remember what I read online.
7	When online text becomes difficult, I re-read it to increase my understanding.
8	When I read online, I guess the meaning of unknown words or phrases.
9	I critically evaluate the on-line text before choosing to use information I read online.
10	I can distinguish between fact and opinion in online texts.
11	When reading online, I look for sites that cover both sides of an issue.

Table 3. Items under Support strategy

No.	Item
1	I have a purpose in mind when I read online.
2	I participate in live chat with other learners of English.
3	I print out a hard copy of the online text then underline or circle information to help me remember it.
4	I use reference materials (e.g., an online dictionary) to help me understand what I read online.
5	I paraphrase (restate ideas in my own words) to better understand what I read online.
6	I go back and forth in the online text to find relationships among ideas in it.
7	I ask myself questions I like to have answered in the online text.
8	When reading online, I translate from English into my native language.
9	When reading online, I think about information in both English and my mother tongue.

This survey was adapted to examine ESL learners' metacognitive reading strategies in online environments when using generative AI. Learners were asked to rate the frequency of their strategic behaviours, such as planning, monitoring, and problem-solving, while interacting with AI to support reading comprehension and information processing.

A pilot test involving 36 respondents was conducted to assess the reliability of the instrument (OSORS). The data were analysed using Cronbach's alpha to determine internal consistency. All responses were valid, and no cases were excluded from the analysis. The Cronbach's alpha value obtained ($\alpha = .955$) demonstrates excellent internal consistency across the 38 items, indicating that the instrument is highly reliable for further use.

Data Collection and Analysis

The data were collected using a standardised questionnaire distributed through a Google Form, which enabled efficient and organised data collection. Responses were automatically compiled and exported into a spreadsheet format for further analysis using Microsoft Excel. The collected data were then analysed using descriptive statistical methods with the assistance of IBM SPSS Statistics. Both graphical and numerical techniques were applied to summarise and interpret the dataset.

Several statistical procedures were used in the analysis, including tests for normality to assess whether the data followed a normal distribution. Descriptive measures such as percentages, means, and standard deviations were calculated to summarise the central tendency and variability of the responses. These descriptive statistics provide insight into the distribution of the most and least used metacognitive strategies. In addition, a paired sample *t*-test was conducted to compare the means of two related groups and determine whether there was a statistically significant difference between them (Pallant, 2020). This

test indicates how these pairs affect each other (i.e., Pair 1: Global – Problem Solving, Pair 2: Global – Support, Pair 3: Problem Solving – Support).

Qualitative data analysis for the open-ended question involved a systematic process of interpreting students' responses to identify patterns and themes. Initially, all responses were transcribed and read multiple times to achieve familiarisation with the data. This was followed by an open coding process, where significant words, phrases, or ideas were labelled to capture key concepts emerging from the data.

Table 4 summarises the research questions, methodology, and analysis.

Table 4. Summary of research question, methodology and analysis

Research questions	Methodology	Analysis
What is the purpose of using AI among these language learners?	Quanty + Qualy	Percentage Thematic
What are the main (top 10) metacognitive reading strategies used while reading responses from AI?	Quanty	Mean score
What are the least (bottom 5) metacognitive reading strategies used while reading responses from AI?	Quanty	Mean score
Is there a significant difference among the metacognitive reading strategies (Global, Problem Solving and Support) used while reading responses from AI?	Quanty	Paired sample *t*-test

FINDINGS

Background Information

A total of 241 learners from a local university responded to the survey. The data show that 67.6% were female and 32.4% were male. The majority (88%) stated that they use AI, while 12% said they do not use AI. Respondents were also asked about the frequency of their AI use. Figure 5 illustrates the findings.

The learners mainly used AI frequently (47.7%). However, 28.2% of the learners reported "Rarely" using AI. 11.6% of the learners reported "Very frequently", which overall indicates significant use of AI among them.

The main findings of the survey are presented according to the research questions.

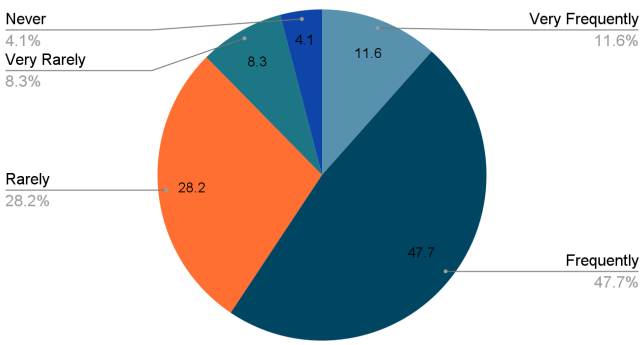


Figure 5. Frequency of AI use

Purpose of Using AI

To address the first research question, both quantitative and qualitative analyses were employed, with the qualitative findings serving to complement and provide deeper insights into the quantitative results. The findings are presented as follows.

The survey identified five main purposes for students' use of AI. The findings indicate that most students reported using AI primarily for assignments (69.8%). This suggests that AI is largely seen as a cognitive support tool rather than a source of entertainment, as entertainment-related use recorded one of the lowest percentages (37.3%). This implies that students use AI to assist with complex cognitive processes involved in academic tasks, such as generating ideas, organising arguments and accessing additional information. These functions align with theories of cognitive support, where external tools act as extensions of learners' information-processing capacity. A theme emerged from the open-ended question that highlighted using AI primarily for research and idea generation. By leveraging AI to explore content and expand perspectives, the learner demonstrates an awareness of gaps in knowledge and actively seeks tools to regulate and enhance understanding. For instance, one of the responses stated that, "can get ideas for questions that hard to understand" as the purpose of using AI. Furthermore, under a similar theme, a student highlighted the use of AI for brainstorming, which reflects a strategic approach to idea development and aligns with higher-order thinking processes within the cognitive domain, particularly in terms of generating, organising, and evaluating ideas. Hence, students use AI as a catalyst to initiate their cognitive processes, particularly in idea generation. This is especially evident in the use of generative AI, where students mostly rely on such tools to support the development and expansion of their ideas. According to Freeman (2025), the primary purpose of AI use is text generation (64%), surpassing other functions such as writing revision and data analysis.

This study found that creative writing (64.9%) and translation (54.4%) were also among the main purposes for using AI. For example, students may use AI to evaluate alternative perspectives, refine arguments, or check linguistic accuracy, demonstrating awareness of their own learning limitations and strategies for improvement. In the context of ESL reading, these practices may affect how learners process and interpret texts. AI-assisted translation and idea generation can support vocabulary development and comprehension, especially when learners encounter unfamiliar language structures. Interestingly, a response from the open-ended question stated that AI helped "improve his English" points toward the role of AI as a form of scaffolding, consistent with Vygotsky's sociocultural theory. In this context, AI functions as a linguistic support, feedback, and models of language use, enabling the learner to perform beyond their current proficiency level within the Zone of Proximal Development (ZPD). Nonetheless, excessive reliance on AI-generated explanations may limit opportunities for deeper inferencing and critical reading. This suggests that, while AI tools can scaffold comprehension and strategy use, they should complement rather than replace active cognitive engagement with the text. These uses reflect aspects of metacognition, where learners actively monitor and regulate their learning strategies.

However, the relatively low use of editing tools such as Grammarly (37.3%) suggests that students may prefer multifunctional AI platforms that integrate several cognitive supports rather than relying on specialised tools. From the open-ended question, editing tools like Grammarly were mentioned to help lessen the cognitive load. AI helps to ensure that sentences are "clear, consistent", and structured, resulting in more "academically enhanced writing". The tool minimises grammatical or structural errors and reduces the mental burden associated with checking for these issues during the writing process. Over time, such support may be internalised, contributing to cognitive development and greater learner autonomy.

Finally, only 6.1% of respondents reported not using AI at all, indicating that AI-assisted learning is now almost ubiquitous. Nevertheless, while AI can enhance idea development and linguistic accuracy, excessive reliance may limit deeper cognitive engagement if students delegate higher-order thinking processes to AI systems.

The findings for research question 1 suggest that students primarily use AI as a cognitive support tool for academic tasks, including idea generation, assignment completion, and language support. These practices align with metacognitive reading strategies, particularly in planning, monitoring, and evaluating comprehension. AI also serves as a scaffold within the ZPD. Variations in AI use indicate differing levels of strategic engagement, providing a basis for examining the most and least frequently employed metacognitive reading strategies.

The Main (Top 10) Metacognitive Reading Strategy Used

Figure 6 and Table 4 show that Problem Solving strategies dominate the top four strategies. According to Mokhtary and Sheorey (2002), students work directly and consciously with the text to solve problems while reading, such as rereading or checking their understanding. For example, in this study, "when online text becomes difficult, I re-read it to increase my understanding" (M = 4.11) is ranked highest among all the strategies, signifying the prudent steps students take as they read online. Students seek solutions to their reading problems. Hamid et al. (2020) also argued that the Problem Solving strategy was dominant, as it involves specific reading techniques when encountering reading challenges. In the age of AI, it is paramount that students are consciously aware of the need to evaluate and seek solutions while reading texts. They need to check for understanding and the reliability of information (Ramli et al., 2011; Jusoh & Abdullah, 2015; Azmuddin et al., 2017; Rianto, 2022; Urban et al., 2025).

Following the top four strategies are the Global strategies. Global strategies are those that students use before reading, such as having a purpose in mind. Planning their reading by using techniques like setting a purpose and previewing the text can serve as a guide while reading (Mokhtari & Sheorey, 2002). Statements such as "I think about whether the content of the online text fits my reading purpose" (M = 4.00) and "I think about what I know to help me understand what I read online" (M = 3.97) indicate that these students have a purpose that motivates them to explore further when searching for information. According to Ramli et al. (2011), Global strategies are predominantly used by adult, mature learners who mostly read online with a purpose in mind. The time spent reading online was a factor that encouraged them to read with purpose.

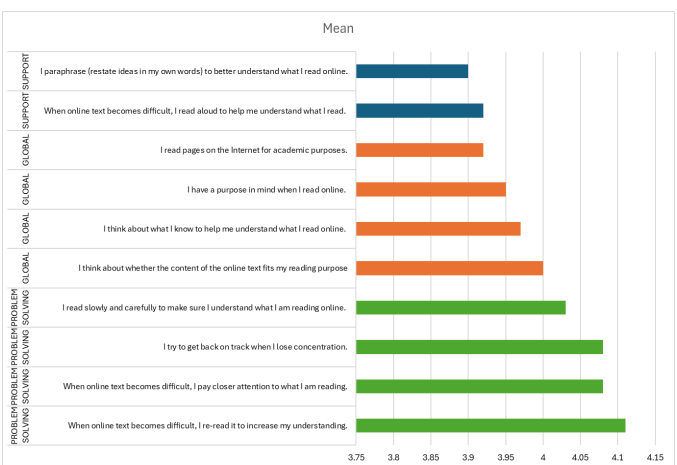


Figure 6. Most used metacognitive strategies

Table 4. Most used metacognitive strategies (total score)

Metacognitive strategy	Item	Total score	Mean
PROBLEM SOLVING	When online text becomes difficult, I re-read it to increase my understanding.	991	4.11
PROBLEM SOLVING	When online text becomes difficult, I pay closer attention to what I am reading.	984	4.08
PROBLEM SOLVING	I try to get back on track when I lose concentration.	983	4.08
PROBLEM SOLVING	I read slowly and carefully to make sure I understand what I am reading online.	971	4.03
GLOBAL	I think about whether the content of the online text fits my reading purpose.	963	4.00
GLOBAL	I think about what I know to help me understand what I read online.	956	3.97
GLOBAL	I have a purpose in mind when I read online.	952	3.95
GLOBAL	I read pages on the Internet for academic purposes.	945	3.92
SUPPORT	When online text becomes difficult, I read aloud to help me understand what I read.	945	3.92
SUPPORT	I paraphrase (restate ideas in my own words) to better understand what I read online.	941	3.90

The Least (Bottom 5) Used Metacognitive Reading Strategy

Figure 7 and Table 5 show that the least used strategies were the Global and Support strategies. Among the least used Global strategies is using live chat with other English speakers and learners (M = 2.68). This finding is consistent with previous studies indicating that ESL/EFL learners prefer conversation practice with AI rather than real human interaction. AI-powered conversation fosters motivation by creating a safe environment for language use (Ba et al., 2025; Sharma et al., 2024; Woo & Choi, 2021). This finding also suggests that while AI-supported environments enhance convenience and confidence, they may reduce opportunities for authentic interaction with human speakers. From the perspective of metacognition and self-regulated learning, excessive reliance on AI could limit deeper cognitive engagement and spontaneous language negotiation.

Printing a hard copy of an online text is the least used strategy to support online reading (M = 2.83). Learners today are apparently accustomed to reading on screen (Tazijan et al., 2022; Liman Kaban & Kadeniz, 2021; Singer & Alexander, 2016). Reading a hard copy is not considered an option for increasing understanding. However, an earlier study by Anderson (2003) mentioned that reading from a hardcopy encourages the use of higher order thinking processes or regulated metacognitive strategies. The preference for screen-

based reading only encourages surface-level processing, highlighting the need to balance AI assistance with strategies that promote deeper comprehension and reflective learning.

Interestingly, Problem Solving did not appear among the least frequently used metacognitive strategies. The least utilised strategies, however, reveal the self-regulatory traits that students display when engaging in reading activities through AI-assisted platforms. The development of metacognitive awareness or self-regulation may be further strengthened when learners consciously evaluate their individual preferences and needs, whether AI-assisted or not (Rashid, 2025).

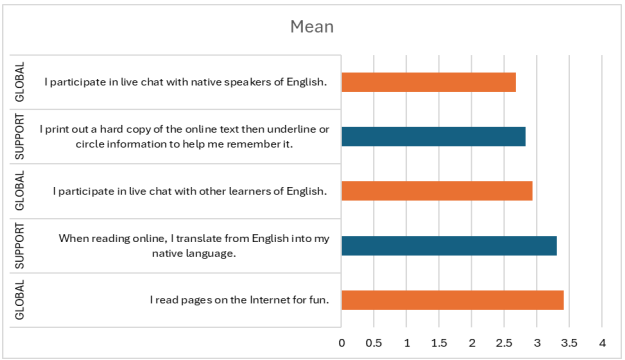


Figure 7. Least used metacognitive strategies

Table 5. Least used metacognitive strategies (total score)

Metacognitive strategy	Item	Total score	Mean
GLOBAL	I read pages on the Internet for fun.	823	3.41
SUPPORT	When reading online, I translate from English into my native language.	797	3.31
GLOBAL	I participate in live chat with other learners of English.	706	2.93
SUPPORT	I print out a hard copy of the online text then underline or circle information to help me remember it.	682	2.83
GLOBAL	I participate in live chat with native speakers of English.	647	2.68

Significant Difference Among the Metacognitive Reading Strategies (Global, Problem Solving, and Support) Used

A paired samples test was conducted to determine the significance of these results. The paired samples *t*-test compared the mean differences among the three metacognitive reading strategies. This is important because, by using this paired *t*-test, the results empirically validate whether participants possess the cognitive maturity to distinguish between high-level mental processes and basic reading aids (Creswell & Creswell, 2018).

Table 6. Paired samples test

Pair		Paired differences					*t*	df	Sig. (2-tailed)
		Mean	S. D.	Std. error mean	95% confidence interval of the difference				
					Lower	Upper			
Pair 1	Global – Problem	–.19720	.31211	.02011	–.23681	–.15760	–9.809	240	.000
Pair 2	Global – Support	.05625	.46105	.02970	–.00226	.11475	1.894	240	.059
Pair 3	Problem – Support	.25345	.45906	.02957	.19520	.31170	8.571	240	.000

The results in Table 6 show key differences among the strategy categories examined. For Pair 1 (Global – Problem Solving), the mean difference is –0.19720, with t = –9.809, df = 240, and p = .000. As the significance value is less than 0.05, this indicates a statistically significant difference between the global and problem scores. The negative mean difference indicates that the problem score is higher than the global score. The 95% confidence interval (–0.23681 to –0.15760) does not include zero, further confirming the significance of the difference.

For Pair 2 (Global – Support), the mean difference is 0.05625 with t = 1.894 and p = .059. As the p-value is greater than 0.05, the difference between global and support scores is not statistically significant. The confidence interval (–0.00226 to 0.11475) includes zero, indicating that the observed difference may be due to sampling variation.

For Pair 3 (Problem Solving – Support), the mean difference is 0.25345, with t = 8.571 and p = .000, indicating a significant difference between problem and support scores. The positive mean difference suggests that problem scores are higher than support scores, and the confidence interval (0.19520 to 0.31170) confirms this finding.

These results indicate that Problem Solving strategies differ significantly from both Global and Support strategies, suggesting that respondents may engage more strongly with problem-focused aspects than with broader global perceptions or supportive elements. The non-significant difference between global and support suggests that these two constructs may overlap conceptually or be perceived similarly by respondents. This pattern may imply that, while participants recognise specific problems distinctly, their overall perceptions and supportive considerations remain relatively aligned. Therefore, future analysis may benefit from exploring whether the constructs measured under global and support categories are sufficiently distinct, or whether additional variables are needed to better capture differences in these dimensions.

DISCUSSION AND IMPLICATION

This research provides significant implications for the stakeholders affected by this revolutionary technology. The discourse centers on the importance of metacognitive awareness, which is considered to play a vital role in enhancing learners' involvement in AI-assisted reading activities. Learners with metacognitive awareness have a better opportunity to recognise the potential of AI and learn to use it more efficiently, as opposed to merely using it. For instance, highlighting significant terms, recording responses, and rewriting what is read have traditionally been considered conventional scholarly practices, but they have also become essential metacognitive strategies that help learners to comprehend and improve reading behaviours. The research found that, for ESL learners, AI can assist learners in monitoring language processes such as idea generation, content translation, and editing written content. This is supported by both the quantitative and qualitative findings on the purpose of using AI. The research findings on learners' purposes for using AI have shown consistency with Freeman's (2025) findings, where most learners used AI to improve and edit their ideas. AI is used to assist learners in linguistic performance and is considered efficient.

The most used strategy found from this study is Problem Solving which shows that learners tend to use AI as a tool to assist them in solving immediate linguistic challenges and generating adequate responses to unexpected vocabulary and concepts. By using Problem Solving strategies, learners have shown a more significant level of self-regulation, using AI as a support system to improve and evaluate learners' responses. However, over-reliance on AI might result in a lack of opportunities for engaging productively with texts and might also influence cognitive skills such as decision-making, critical thinking, and analytical reasoning skills (Zhai et al., 2024). Meaningful learning happens only when students are able to analyse, evaluate, and interpret what they are learning. In second language acquisition, scaffolding of learning is made possible through tools such as AI, which help students in areas such as idea generation, vocabulary building, and language editing (Vygotsky, 1997). This helps students as they go through various language difficulties and become more independent in language use. However, at some point, students need to use higher cognitive skills for more in-depth learning and understanding of reading material and become more independent in reading skills. Meaningful reading requires students to interact productively with what they are reading and also what they know (Carrell et al., 1988). This requires students to constantly evaluate, monitor, and regulate their learning.

With the help of AI, it is possible to develop and improve metacognitive skills. These include features of AI that allow learners to engage in dynamic interaction with texts, such as highlighting words/phrases that they find hard, creating definitions, and summaries. These allow for more personalised and self-directed learning. However, this is highly dependent on the learner's capacity for metacognition. If this is lacking, it is likely that they will misuse this technology and hinder their progress in learning and developing language skills. The results of this study revealed that learners prefer interacting with AI compared to human interaction, as they believe it helps build their confidence. However, this can hinder

effective interaction and spontaneity, which is a unique feature of human interaction. This is in line with the recent study by Anders and Speltz (2025) on AI literacies and self-regulation, which revealed that learners are increasingly using AI in their academic self-regulation. Although this helps in improving some of their self-regulated learning skills, such as planning and monitoring, it is likely that they will develop a dependency on AI-generated support (Hwang et al., 2025; Wang et al., 2025). It is important for learners to develop AI literacy skills, which require critical thinking and not blind acceptance of AI-generated feedback.

The last research question of this study reveals that the application of Problem Solving strategies far outweighs the application of Global and Support strategies. This may have positive implications for the effects of AI use, as it may suggest learners are engaging in active problem-solving for comprehension issues. However, it is important to note that while this may be the case, it does not mean that learners are not engaging in any active process for understanding the texts they are reading. It may mean they are becoming increasingly reliant on the use of AI for problem-solving and critical reading skills.

In addition, in this study, borrowing the same concept of scaffolding, the support that a learner received from their interactions with AI and their application of multiple metacognitive strategies will result in the expansion of their ZPD. Thus, making comprehension in reading to be more enhanced, fast and meaningful. Looking back, scaffolding in the past has always been connected with learners' interactions with other learners and these social interactions achieved via online forums or any social media platform which have been proven to be effective in learning (Pramela et al., 2011; Hussin, 2008). Today, taking over the role and benefits of online learning platforms or forums, the use of AI and its advantages are believed to be able to better assist the learners. The whole idea of this concept is depicted in the following illustration that is adapted from Hussin (2008).

Based on Figure 8, the cent circle represents the actual zone of actual development of the learners and the bold line that circles it is the learners' interactions and utilisation of AI. Such interactions differ based on the selection of metacognitive strategies selected by the learners (in arrows). The outcome of this process will result in the expansion of the actual development zone that is depicted by the dotted lines. In short, this process is believed to be able to enhance and accelerate reading comprehension. Hence, with an effective use of metacognitive strategies, learners may avoid overreliance and have a more meaningful learning experience or in this case their online reading comprehension.

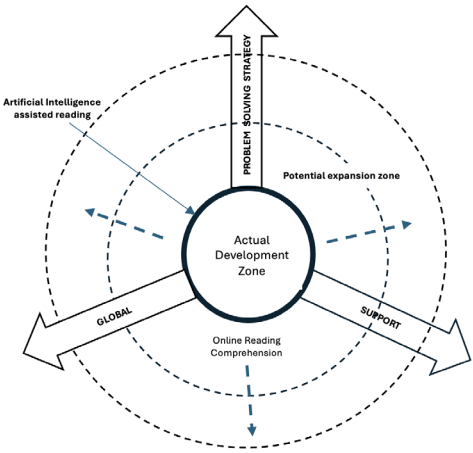


Figure 8. Reading comprehension and metacognitive strategies in AI assisted reading (Adapted from Hussin, 2008)

CONCLUSION

The primary goal of AI-assisted language learning is the development of metacognitive skills in learners. It is important for instructors to develop tasks that make use of AI and, at the same time, encourage learners to reflect on their use of AI, the information they learn through it, and its impact on their comprehension and retention of material. Cohen (2003) suggested that strategy training for second-language learners is beneficial. It is therefore important for learners to have access to online reading tools that promote active engagement through tools such as note-taking space, digital annotation, and tracking of progress for self-regulation. For AI developers, this study provides a future direction for the development of human-centered AI, not only for answering questions but for promoting thinking, reflection, and strategy development as well. All in all, for AI to be effective in language learning, it is not only important for developers to innovate in this field but also for instructors to promote learner empowerment through metacognition development. Moreover, it is important for further research on AI and its impact on metacognitive awareness in other fields of study for a wider perspective in this field of study.

Another important issue is the ethical issue of AI in language learning. It is important for instructors and developers of AI to consider this issue in order to avoid its negative impact on learners. The frequent use of AI in assignments by learners is a sign of its integration in this field of study and therefore calls for more attention and development of guidelines on its application in language learning. As this study shows, AI is used in almost all aspects of learning and is therefore important for its integration in this field of study and its cognitive and pedagogical implications for users to be understood and accepted by learners. Ultimately, this study provides insights into more effective and ethical integration of AI in language learning, particularly in online reading.

LIMITATIONS

This study has certain limitations. For further research, qualitative longitudinal studies are recommended to enhance the description of students' cognitive processes. This would provide insights into the familiarity with shifts in strategy use. As this study is based on self-reported data, the findings may reflect participants' subjective views rather than actual behaviours. Future studies could incorporate observational or performance-based measures for validation. Data for this study were also gathered from a single university due to time and resource constraints; future research may include more respondents to allow for more in-depth analysis.

DATA AVAILABILITY

The datasets gathered and generated during this study are not publicly available due to concerns about participant confidentiality. However, they may be obtained from the corresponding author upon reasonable request.

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