

Examining Relationships between Language Learning Strategies and AI: A Study of Chinese EFL Learners' Writing Practices

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Andrew Schenck

American University of Sharjah, Sharjah, United Arab Emirates
<aschenck@aus.edu>

Caiyun Zhang

Kansas International School, Zhengzhou Sias University, Xinzheng, China
<caiyunzhang2006@126.com>

Sharon Graham

Fort Hays State University, Fort Hays, United States
<sagraham2@fhsu.edu>

Abstract

There are undeniably some contributions of AI to language learning, yet it is still unclear how such technology should be used with known language learning techniques to improve instruction. To address this gap in our understanding, a survey concerning metacognitive, cognitive, and socio-affective learning strategies was given to 511 Chinese EFL learners, along with another survey about using AI for different parts of the writing process (brainstorming, research, outlining, writing, and revision). Results were then correlated using the Spearman rho formula. Findings revealed that metacognitive strategies were linked to a reduction of AI for preliminary planning of writing (brainstorming and research). Specific metacognitive strategies related to goal setting were also associated with less use of AI for outlining. In contrast, cognitive language learning strategies were more closely associated with AI use throughout the writing process, which included finding research, writing an outline, and writing essays or homework assignments. Socio-affective learning strategies appeared to reduce the amount of AI used to revise writing content. Overall, results appear to suggest that targeted metacognitive strategies can help to promote individual autonomy and reduce overreliance on AI. Limiting AI to revision may also promote metacognitive strategy development during other stages of the writing process.

Keywords: metacognitive strategies; cognitive strategies; socio-affective strategies; EFL; AI; language learning

AI tools have transformed how educators approach language learning in the classroom. For some, it is a godsend, serving as a personal tutor which can provide learners with scaffolded tasks and instant feedback (Bin-Hady et al., 2023; Qiao & Zhao, 2023). Such technological support may reduce negative attitudes about the learning process. Research suggests that immediate feedback from programs like ChatGPT often helps to reduce anxiety, providing an outlet for reluctant learners to ask questions without fear of ridicule or judgement (Solak, 2024; Yang & Kyun, 2022). AI support may also cultivate positive feelings about the educational process. In a recent study of AI chatbots, 176 undergraduate learners who were given a module integrating AI and language learning gained positive attitudes about the utility and efficacy of the technology (Belda-Medina & Calvo-Ferrer, 2022).

Despite the potential positive applications of AI tools to language learning, there are some key limitations. First, learners do not interact with real humans when using this technology. Whereas LLMs can help with modelling and assessment of learning, teachers are still needed to motivate, activate prior knowledge, and provide a framework for academic achievement (Liu et al., 2024). An additional problem with AI tools is that they often misconstrue cultural nuances and pragmatic information associated with diverse language styles. Concerning this issue, Jeon et al. (2025) explains that “GenAI systems are designed to operate in the realm of statistical probability, standardizing what is already prevalent in society and under-representing minority voices” (p. 1). As suggested by the quote, the homogeneity of AI helps to promulgate trends or biases that reduce diversity. A final issue with AI is its limited ability to understand creative language (De la Vall & Araya, 2023). In the field of writing, this may be a serious issue. Learners may be inundated with standardized text examples or feedback, which limits critical thinking and independent writing skills needed to make compositions unique (Graham & Milan, 2025).

Due to limitations associated with the use of AI, research has recognized the role of teachers in moderating and supporting adaptations of AI technology in the language learning classroom (Woo et al., 2025; Yang & Kyun, 2022). It has also recognized the importance of cultivating student strategies for self-assessment, independent learning, and transfer of new skills (Liu et al., 2024). While the research is an important step forward, it often relies on more general learning frameworks to explain how students interact with AI. Additional research is needed to examine the impact of specific language learning strategies on the use of AI. Such study may heighten our understanding of how discreet strategies should be adapted to different educational tasks, thereby maximizing the effectiveness of AI-assisted instruction.

Literature Review

The potential utility of AI chatbots for language learning is clear. They offer practice and feedback that will scaffold the language learning process. Research suggests that this scaffolding can reduce cognitive load, foster ideation, and promote self-regulated learning (Li & Wilson, 2025). At the same time, dependence on AI assistance for extensive periods may have some adverse effects on cognitive development (Mohebbi, 2024; Yang, 2024). This perspective is exemplified by a recent systematic review, which found that overreliance on AI caused learners to “increasingly favor fast and optimal solutions over slow ones constrained by practicality” (Zhai et al., 2024, p. 1). By providing easy shortcuts for production, AI tools may deprive learners of acquiring valuable input and output processing skills that promote better language development.

Due to the extreme power and efficacy of AI tools like ChatGPT, there are concerns that learners may not obtain higher-order thinking skills (Derakhshan & Taghizadeh, 2025). While AI tools can help students gain some of these skills (Ilgun Dibek et al., 2024), there may be limitations with respect to promotion of deep, creative, and complex problem solving (Dimeli

& Kostas, 2025). Past research reveals that language learners need “executive” input and output processing skills, referred to as metacognitive strategies, to help them plan for learning, think about the learning process as it is happening, monitor one’s own production, and evaluate learning after an activity is completed (Purpura, 1997). Such strategies help learners consciously focus on their own development, leading to heightened independence and success when learning a language (Rahimi & Katal, 2012; Wenden, 1998). Concerning these metacognitive strategies, Brown (2007) described the following types:

1. Advance organizers – Making a comprehensive preview before a learning task.
2. Directed/Selected attention – Deciding to attend to a specific aspect of a learning task while ignoring distractors.
3. Self-management – Understanding the conditions needed to learn and arranging for the presence of these conditions.
4. Functional Planning – Planning for and rehearsing aspect of a language needed to perform a task.
5. Self-Evaluation – Checking the outcomes of one’s own language learning against an inner sense of completeness and accuracy. (p. 134)

Metacognitive skills help a learner to adapt their language skills in diverse pragmatic contexts through planning, reflection, and evaluation. In response to the need for such skills, educators have developed learning methods like the SQ3R, which promote effective learning through **S**urveying reading material in advance, asking **Q**uestions to guide the reading, **R**ead to find useful information, **R**eciting or reading aloud, and **R**eview (Hornby & Greaves, 2022). It is important to note that metacognitive skills may be useful in all areas of language learning to include speaking, listening, reading, and writing. Furthermore, multiple modalities are often integrated within just one language task. Concerning academic writing, for example, construction of persuasive texts requires reading and listening, as learners evaluate texts or videos to enhance support for a proposition. Speaking is also required when peer review is initiated. Research further suggests that learning strategies often transfer to different language tasks or modalities (Belaman et al., 2025; McKeachie, 1987). Due to the integrated nature of language tasks, metacognitive strategies should be considered in multiple modalities. Regarding writing, research has acknowledged the importance of a multimodal approach to evaluation (Yang & Plakans, 2012, p. 80).

Although past research has established the importance of metacognitive strategies, modern research of AI has reignited a debate over their significance. Some research suggests that AI tools are more useful than metacognitive instruction. For example, a recent study found that business students trained with AI-powered chatbots outperformed learners taught with metacognitive approaches (Chen & Anyanwu, 2025). Other research recognizes the synergistic power of using AI tools with metacognitive instruction. For example, a recent study of EFL learners found that AI writing aids were most effective when provided along with metacognitive training (Gayed et al., 2022). There does indeed appear to be an essential link between metacognitive awareness and effective adaptation of AI tools (Filiz & Gür, 2025). This view is exemplified by a recent study, which found that employees with high metacognitive ability can increase creativity with the assistance of LLMs (Sun et al., 2025).

Debate concerning the need for metacognitive awareness reflects a gap in existing research, which has not adequately examined the relationship between AI tools and metacognitive strategies. A recent study has tried to close this gap, investigating how AI chatbots may provide multiple different types of feedback, to include metacognitive, affective, and neutral feedback

(Yin et al., 2025). Although this study provides insights concerning how AI may generate metacognitive awareness, it does not evaluate the potential impact of metacognitive strategies on the use of AI. Other research has examined the reciprocal relationship between AI tools and human development (Aladini et al., 2025; Faza & Lestari, 2025), yet it does not adequately explain the connection between specific metacognitive strategies and different AI usage patterns. In-depth investigation is needed to identify the impact of discreet metacognitive techniques for planning, directed attention to tasks, self-management, and self-evaluation. Diverse learning approaches may have different effects on how AI is utilized, exemplifying a need for additional research. Further study may help teachers and students select appropriate metacognitive strategies based upon characteristics of a specific learning task.

As in the case of metacognitive strategies, the relationship between cognitive strategies and AI-assisted language learning is not well understood. While metacognitive strategies stimulate conscious reflection of one's own thought processes, cognitive strategies focus on the acquisition or reorganization of knowledge through the recombination of linguistic elements, deductive application of rules, retention of sounds, and contextualized evaluation of word meanings. Concerning language learning tasks associated with essay writing, cognitive strategies may be used for notetaking, paraphrasing, or translation (Xiong & Hiew, 2024). Like their metacognitive counterparts, the relationship between cognitive strategies and AI is not concretely understood. In one study, AI promoted cognitive strategies that use logical reasoning, define problems, and structure arguments. At the same time, learners revealed weaknesses concerning novel idea generation or critical evaluation of unsupported conclusions (Musazade et al., 2025). Other studies suggest that linguistic tasks that require restructuring are adversely impacted by AI, due primarily to the provision of ready-made suggestions that preclude creativity (Boers et al., 2025). Cognitive learning strategies may also have an impact on how AI is used. A recent study revealed that learners who preferred using cognitive strategies relied less on AI tools (Moşoi et al., 2025). While such research is insightful, it remains limited, revealing a need for further study to confirm and expand the findings.

Like metacognitive and cognitive strategies, socio-affective learning techniques appear to be closely related to the use of AI (Suárez Riveiro & Fernández Suárez, 2011). Socio-affective strategies are defined as a form of engagement or interaction which enables “learners to control feelings, motivations, and attitudes related to language learning” (Oxford, 1990, p. 71). Through using these techniques, learners can make behavioral choices to help maintain positive attitudes about the language learning process. For example, students can cultivate attentiveness by interacting with others (e.g. asking questions in class or speaking with peers or teachers outside the classroom) or generate interest through engaging with language learning materials outside the classroom (e.g., reading magazines or novels after class or watching English movies or TV) (Oxford, 2002). The application of socio-affective strategies may affect how AI is utilized for language tasks of various modalities, including writing. Learners who cultivate self-interest through interaction and engagement with English materials may also use AI in beneficial ways. Although there is a potential link between socio-affective strategies and AI usage patterns, little research exists to examine the relationship. Modern research often focuses on educator-led interventions, which show that AI-assisted learning can be used to cultivate positive emotions and interest (Khasawneh et al., 2025; Xiao et al., 2024). While insightful, this research does not adequately examine the learner's role in choosing strategies for AI-assisted learning. More research is needed to examine potential relationships between socio-affective techniques and the use of AI (AlTwijri & Alghizzi, 2024).

Review of relationships between language learning strategies and AI reveals a significant gap in our understanding. Further investigation is needed so that pedagogical techniques can be tailored to specific AI-assisted language learning activities. To address the need for additional

research, the present study was designed to collect information about how metacognitive, cognitive, and socio-affective language learning strategies are used with AI to complete different EFL writing tasks. Such study may yield new insights, allowing educators to use language learning strategies with AI that increase productivity and maximize acquisition.

Research Questions

To examine the relationship between language learning strategies and utilization of AI tools, the following questions were posed:

1. In what ways are metacognitive strategies related to the utilization of AI tools for writing? How might these relationships be utilized to enhance language learning?
2. In what ways are cognitive language learning strategies related to the utilization of AI tools for writing? How might these relationships be utilized to enhance language learning?
3. In what ways are socio-affective learning strategies related to the utilization of AI tools for writing? How might these relationships be utilized to enhance language learning?

Method

Little is known about how learning strategies influence the use of AI with language tasks. Therefore, the present study was designed to collect student data concerning language learning techniques and the use of AI for EFL writing.

Instruments

To elicit information about language strategy use, twenty questions were selected from the “Questionnaire for English Majors at Nankai University, China” to create a survey (Xiao, 2004). The survey is a valid measure for the target group, since it was developed to examine Chinese EFL learners’ attitudes about learning English, as well as learning practices. The survey provides eight questions about metacognitive strategy use related to planning, monitoring, and self-regulation (Questions 1-8). Secondly, the survey provides eight questions about cognitive learning strategies that focus directly on manipulating linguistic elements to acquire new knowledge. The questions focus on different ways to analyze and understand language, reflecting the cognitive strategy target variable (Questions 9 and 11-17). Finally, the survey provides four questions related to socio-affective learning strategies, which reflect a desire to either receive English input (e.g., reading or listening) or produce output (e.g., speaking or writing) (Questions 10 and 18-20). The questions explore multiple modalities related to reading, writing, listening, and speaking. As previously explained in the literature review, writing tasks often require multiple modalities for completion. For example, the Chinese university students who participated in this study had persuasive essay assignments that required research of both textual and visual media, ensuring that multimodal assessment of language learning strategies was appropriate. Research further confirms that metacognitive, cognitive, and socio-affective learning strategies often transfer to different tasks or modalities (Belaman et al., 2025; McKeachie, 1987), exemplifying a need for holistic examination of different language learning techniques. Students responded to survey questions by providing a Likert scale score which ranged from 1 (Strongly disagree), 2 (Disagree), 3 (Neutral), 4 (Agree), 5 (Strongly agree). Collectively, the questions provide a comprehensive view of language learning habits and interests, which can be compared to the habits of AI use for writing (See Appendix A for more information). To examine reliability of the instrument, internal consistency was evaluated using Cronbach’s alpha. Calculation resulted in a high value of $\alpha = .93$, suggesting that the instrument is a highly reliable measure of English language learning strategies.

In order to examine the use of AI in writing, a survey was designed to elicit information about how often AI tools were utilized throughout the writing process. The survey included seven questions about brainstorming, research, outlining, writing, and revision (See Appendix B). Students responded to these questions by providing a Likert scale score which ranged from 1 (Not at all true), 2 (Not true), 3 (Somewhat true), 4 (True), 5 (Very true). To examine reliability of the instruments, internal consistency was evaluated using Cronbach's alpha. Calculation yielded an acceptable value $\alpha = .80$, suggesting that the instrument has an acceptable measure of reliability.

Both surveys were translated into Chinese by an instructor of English with the Chinese L1. The translations were checked to ensure that they were valid and accurate versions of the originals.

Participants

Participants for the study were recruited from a university in mainland China. In total, 650 Chinese participants filled out the surveys, 404 female and 246 male. Ages ranged from 18 to 21. Learners' majors included nursing, business administration, finance, English, and information management. Only 511 learners completed both surveys, making it necessary to exclude 139 of the survey respondents.

Procedure

Following IRB approval, survey data was collected. Students were informed that participation was not mandatory, and no adverse impact would result from non-participation. Learners then gave oral consent before taking the survey. Names or other identifying data were not recorded. Data was collected using Microsoft forms. The following demographic information was gathered from participants:

- Age
- Gender
- Major

Following the collection of data, responses were correlated using the non-parametric Spearman Rho formula. This formula was selected since data obtained from the Likert scales was ordinal. Following statistical correlation, significant relationships between language learning strategies and AI use in writing were identified and evaluated.

Results and Discussion

RQ1: Meta-Cognitive Strategies

Spearman-rank correlations of meta-cognitive strategies revealed several significant relationships. As can be seen in Table 1, learners who used meta-cognitive strategies also tended to use AI tools for revision of both content and grammar. Conversely, learners who favored metacognitive strategies did not tend to use AI for brainstorming or finding articles. They also avoided using AI for writing their papers or homework assignments. Only question 4, regarding evaluation of strengths and weaknesses, had a significant relationship to finding articles for writing. This information may suggest that learners who use meta-cognitive strategies take ownership for creating and developing paper topics. Furthermore, metacognitive strategies may promote initiative in finding primary or secondary sources to include in their papers. Conscious regulation of paper topics and research may promote autonomy and creativity at initial stages of writing.

Table 1. Use of Metacognitive Strategies and the Use of AI for Writing Tasks

		Brain- storm	Find articles	Write outline	Revise or edit	Improve content	Improve grammar	Write a Paper
1. I have my own study plan.	r_s	-.012	-.016	.056	.100	.089	.114	-.063
	p	.779	.724	.210	.025	.043	.010	.157
2. I plan to have enough time to study English.	r_s	.001	.077	.069	.108	.065	.140	.014
	p	.974	.081	.121	.015	.145	.002	.750
3. I have clear goals for improving my English.	r_s	.029	.071	.146	.120	.105	.151	.029
	p	.514	.110	.001	.007	.017	.001	.513
4. I think about my progress in learning English	r_s	.040	.091	.097	.170	.113	.141	-.019
	p	.365	.040	.029	.000	.010	.001	.669
5. I assess my own learning strategies	r_s	-.008	.045	.113	.124	.118	.171	-.032
	p	.859	.311	.011	.005	.008	.000	.477
6. I use different learning strategies for different activities	r_s	.053	.017	.115	.149	.097	.153	-.042
	p	.237	.698	.009	.001	.029	.001	.340
7. I select text that match my own English level.	r_s	.039	.083	.144	.127	.106	.083	.050
	p	.375	.062	.001	.004	.017	.060	.255
8. I think about my own personality	r_s	.014	.085	.156	.180	.142	.157	.043
	p	.754	.054	.000	.000	.001	.000	.335

Note: See Appendix 1 for full questions. N-size varies between 506 & 511 due to missing values.

Most learners who used meta-cognitive strategies also used AI to write an outline. However, students with metacognitive skills for planning and scheduling (questions 1 and 2) did not tend to use AI for writing an outline. These learners may feel confident to make plans and organize information via brainstorming, finding articles, and writing an outline. The finding appears to suggest that metacognitive awareness associated with planning helps to reduce a learner's dependence on AI at initial stages of writing development.

Correlations may also reflect the impact of AI on metacognitive strategies. Learners who tend to use AI primarily for revision may be compelled to utilize metacognitive strategies for brainstorming, research, and outline construction. Additional experimental research will be required to better understand the relationship between AI tools and metacognitive strategies so that instruction can be improved.

RQ2: Cognitive Strategies

Cognitive strategies had very different patterns of correlation (Table 2). Learners who used these strategies tended to use AI to find articles more extensively. Perhaps learners who do not consciously reflect on the planning process lack an understanding of how to find and organize information for essays or reports. Learners who employ cognitive strategies may be focused on completion of the language task, which could reduce emphasis placed upon personal development. This perspective may be exemplified by a larger tendency to use AI through every stage of the writing process, with the exception of brainstorming. There may be a focus on task completion. As a result, learners may not focus on the degree to which they are independently learning and developing their writing skills without AI tools. While insightful, further qualitative inquiry is needed to assess the veracity of this interpretation of the data.

Table 2. Use of Cognitive Strategies and the Use of AI for Writing Tasks

		Brain-storm	Find articles	Write outline.	Revise or edit	Improve content	Improve grammar	Write a Paper
9. I try to understand every single word.	r_s	-.012	.080	.074	.071	.069	.096	.073
	p	.778	.073	.095	.110	.120	.030	.100
11. I translate the English text materials into Chinese	r_s	.050	.089	.169	.091	.117	.145	-.001
	p	.263	.044	.000	.041	.008	.001	.980
12. I read aloud the text materials after class.	r_s	-.043	.091	.153	.088	.106	.163	.047
	p	.328	.040	.001	.046	.017	.000	.289
13. I try to analyse the grammar and structure	r_s	.008	.142	.038	.095	.071	.162	.088
	p	.849	.001	.389	.032	.107	.000	.048
14. I try to guess the meaning when I cannot understand	r_s	.018	.092	.141	.173	.095	.133	-.034
	p	.684	.037	.001	.000	.031	.002	.446
15. I recite large chunks of good English text materials.	r_s	.004	.058	.080	.100	.098	.170	.022
	p	.937	.195	.070	.024	.027	.000	.625
16. I intend to understand every word when I listen	r_s	.021	.092	.117	.033	.067	.115	.143
	p	.642	.038	.008	.460	.128	.009	.001
17. I try look up words in a dictionary afterwards.	r_s	.026	.096	.077	.096	.114	.119	.056
	p	.560	.030	.082	.031	.010	.007	.205

Concerning question 13, regarding analyzing grammar and structure, and question 16, regarding a desire to understand every single word, there is a correlation to using AI for writing homework assignments or papers. At the same time, learners who used these strategies did not tend to check the content of their writing. Such a finding may reveal an overreliance on AI to complete writing tasks, whereby the revision process is skipped. It may also suggest that learners are too focused on form-based tasks. The learners may be hyper-focused on form, a result of several years of learning via a grammar-translation approach. As a result, they may use AI for grammar-based tasks and editing.

Cognitive strategies may also be influenced by AI tools. LLMs could serve as a scaffold, ensuring that learners at various proficiency levels complete a writing task. At the same time, they may also decrease the degree of mental effort exerted while applying cognitive strategies, adversely impacting the learning process. Additional research will be needed to further clarify the reciprocal nature of the relationship between AI tools and language learning strategies.

RQ3: Socio-Affective Strategies

In contrast to learners who extensively used cognitive strategies, learners who used socio-affective strategies tended not to use AI extensively for revision or improvement of writing content (Table 3). Socio-affective techniques yielded no significant correlations to the use of AI for improvement of writing content. This finding may have implications for teaching. Socio-affective strategies which cultivate positive attitudes about language learning may reduce how much AI is used in the process of content creation or editing. An additional explanation for the findings would be that limiting how much AI is used to edit content may promote affective interest and the adaptation of socio-affective strategies. More studies will be needed to elucidate the relationship between affective interests in language learning and the degree to which AI is used.

Table 3. Affective Interest in Language Learning and the Use of AI for Writing Tasks

		Brain- storm	Find articles	Write outline.	Revise or edit	Improve content	Improve grammar	Write a Paper
10. I like to read English newspapers, magazines and novels after class.	r_s	-.073	.135	.109	.062	.054	.127	.094
	p	.101	.002	.014	.164	.227	.004	.033
18. I like to answer questions in English in class.	r_s	-.035	.079	.092	.077	.080	.133	.017
	p	.432	.077	.039	.083	.071	.003	.696
19. I often see English language films watch TV programs after class.	r_s	.014	.055	.113	.115	.079	.129	.067
	p	.759	.218	.011	.009	.073	.003	.128
20. I like to speak English with my peers or teachers outside the classroom.	r_s	.006	.093	.124	.094	.073	.135	.019
	p	.886	.035	.005	.035	.097	.002	.673

Conclusion

Results of the present study may suggest that different language learning strategies influence how AI is used for EFL writing. Concerning metacognitive strategies, they are associated with less use of AI for brainstorming and research. Specific metacognitive strategies related to goal setting are also linked to a reduction in use of AI for outlining. These findings could suggest that conscious reflection during the planning process promotes ownership in the writing topic, as well as a desire to achieve mastery without the application of AI tools.

In contrast to metacognitive strategies, cognitive language learning strategies tend to be more closely associated with AI throughout the writing process, to include finding research, writing an outline, and writing essays or homework assignments. Concerning learners who use socio-affective strategies to build interest in class materials, they do not tend to use AI for revision of content. This may have implications for pedagogy. Cultivating affective interest may be a key component of classes where content is edited and reviewed. Thus, teachers should be intentional in their use of activities that develop student motivation and self-confidence while mindfully reducing student anxiety. For example, showing students examples of the editing process employed by well-known authors (such as J.K. Rowling) might help them realize that all writers need to review their work, not just students in language classes. Providing students with tools such as a list of specific questions to guide them through the review and editing process could also help reduce anxiety and build the self-confidence needed to participate actively in the task. The teacher might walk students through a whole-class review of a piece of writing to demonstrate how to identify items that need attention and how to suggest or make revisions (depending on whether the task is a peer or self-review). Providing students with a purpose for writing and editing their work beyond an assignment grade could also improve affective interest; examples include a class or school newsletter, a published collection of student writing at the end of the semester, or a focused project such as a recipe book.

Results may reveal an opportunity to enhance AI-assisted writing instruction through strategic application of different learning strategies (Table 4). Special training in metacognitive skills could be used to reduce overutilization of AI, particularly when completing higher-order thinking tasks like brainstorming, research, or composition. In addition, emphasis of specific metacognitive strategies that target planning or goal setting could reduce reliance on AI when completing an outline. It is important to note that metacognitive skills development may still be essential at each stage of the writing process. In the past, writing tasks could have been completed without a high degree of self-reflection about one's own learning behaviors. However, today's ubiquitous AI-integrated learning environment may lead to overreliance on any compositional task, exemplifying a need for more comprehensive and constant self-

reflection. Concerning cognitive strategies, careful control of AI access could compel learners to increase cognitive effort, reducing the predilection for technological reliance reported in survey data. Finally, socio-affective strategies could reduce dependence on AI when used to revise essay content. Overall, results of the present study suggest that diversification and varied application of language learning techniques could improve instruction. More research will be needed to ensure that language learning strategies are applied at the right time to ensure that AI use is beneficial.

AI tools may also influence how metacognitive, cognitive, or socio-affective strategies are used. As a result, educators will need to carefully regulate AI-assisted tool use according to learner characteristics (Table 4). While learners with metacognitive skills use AI less when higher-order thinking tasks are completed, they still use AI for revision and editing. This reliance may suggest that some restriction of AI is needed during basic editing or revision tasks. In contrast, learners who rely heavily on cognitive learning strategies may require control of AI at almost every stage of the writing process. Limiting AI may compel these learners to think more critically about writing tasks and essay content while guarding against an overreliance on technological assistance. Further limitations may be needed based upon students who lack socio-affective skills or interest in a particular task. Disinterest in specific writing activities may require completion offline before receiving AI feedback. As an illustration, learners who are not interested in editing grammar or vocabulary may be compelled to review their essay (or perform peer review) without AI assistance. Likewise, learners who are not interested in an essay topic may be compelled to complete brainstorming and research without technological assistance. While intriguing, further experimental research is needed to better define how AI should be regulated, ensuring that learners apply different language learning strategies effectively.

Table 4. Language Learning Strategies and Writing Instruction with AI

Learning Strategies	Potential Influences on the Use of AI	Potential Strategies for AI Regulation
Metacognitive Strategies	May reduce the amount of AI used for writing tasks, particularly those requiring higher-order thinking skills like brainstorming, research, outlining, or drafting.	For students who regularly employ metacognitive strategies, AI could occasionally be restricted for editing and revision tasks.
Cognitive Strategies	May result in heightened use of AI for each writing task.	For learners who have the proficiency to write independently, offline completion of tasks that require cognitive strategies may be beneficial. Completion could be followed by the provision of AI generated feedback.
Socio-Affective Strategies	May help to reduce the amount of AI used to develop ideas or revise content.	AI may be restricted for learners who lack socio-affective skills or interest in a specific writing task.

Although the present study has yielded several insights, it also has some key limitations which must be addressed in future research. First, correlations reveal key relationships between language learning strategies and AI, yet correlation does not necessarily prove causation. Additional experimental studies are needed so that individual language learning techniques and their impact on the use of AI can be more concretely discerned. Different interventions should be systematically tested by manipulating the independent variable (the teaching technique) and

observing the dependent variable (AI usage behavior). Furthermore, future studies must examine learning strategies with different types of EFL tasks that use AI (e.g., structured vs. open-ended tasks, individual vs. collaborative tasks, or receptive vs. productive tasks). Finally, research should move beyond the present study's evaluation of internal metacognitive, cognitive, and affective strategies to explore the impact of AI on external social learning practices. Such research may help educators understand how to use learning strategies and AI tools at the right time. This understanding may, in turn, allow educators to maximize the effectiveness of AI-assisted language instruction.

About the Authors

Andrew Schenck is currently an Assistant Professor of English at the American University of Sharjah in the UAE. He has taught English for over 20 years at universities in the USA, South Korea, China, and the UAE. His research examines influences on English education and leadership, highlighting the need to develop teaching techniques that address the needs of diverse learners. ORCID ID: 0000-0002-3864-6267

Caiyun Zhang is an Associate Professor at Zhengzhou Sias University, where she has worked since 2010 as an EFL teacher in the Kansas International School. Her research and professional interests focus on English as a Foreign Language (EFL) teaching and education. ORCID ID: 0009-0005-1869-1465

Sharon Graham is the Cross-border Education Specialist in the Office of Global Affairs at Fort Hays State University in Kansas. She has a Master of Arts in TESOL and has been teaching for over 20 years in English language programs both in the U.S. and China. Her research and professional interests include cross-border educational partnerships, teacher training and support, and writing. ORCID ID: 0009-0000-8058-7208

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Appendix 1. Questionnaire for English Learners in China

Column Headings for Tasks in Tables 1, 2 & 3

1. Brainstorm or get ideas for my paper.
2. Find articles to use for my writing.
3. Write an outline.
4. Revise or edit my writing.
5. Check and improve the content of my writing.
6. Check and improve the grammar of my writing.
7. Write a homework assignment or paper.

- | |
|---|
| <ol style="list-style-type: none">1. Strongly disagree2. Disagree3. Neutral4. Agree5. Strongly Agree |
|---|

1. Apart from finishing assignments assigned by teachers, I have my own study plan.
2. I plan my schedule so I will have enough time to study English.
3. I have clear goals for improving my English.
4. I think about my progress in learning English so as to find out my own strengths and weaknesses in this regard.
5. I assess my own learning strategies to find out my weaknesses and the ways to overcome them.
6. I use different learning strategies for different learning activities in my English study.
7. I select and read the English language text materials that match my own current English level.
8. I think about my own personality so as to find out my strengths and weaknesses with regard to English language learning.
9. In reading English, I try to understand every single word.
10. I like to read English newspapers, magazines and novels after class.
11. I translate the English text materials into Chinese to enhance my comprehension.
12. I read aloud the text materials after class.
13. I try to analyse the grammar and structure of the sentence when I cannot understand the text.
14. I try to guess the meaning when I cannot understand the sentence.
15. I recite large chunks of good English text materials.
16. I intend to understand every single word when I listen to English.
17. When I come across a new word while listening to English, I intend to remember its pronunciation and look it up in the dictionary afterwards.
18. I like to answer questions in English in class.
19. I often see English language films or watch TV programs after class.
20. I like to speak English with my peers or teachers outside the classroom.

Appendix 2. Technology Survey

Not at all true Not true Somewhat true True Very true
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Tech Habits

I often use AI (DeepSeek, ChatGPT, etc.) to do the following:

1. Brainstorm or get ideas for my paper.
2. Find articles to use for my writing.
3. Write an outline.
4. Revise or edit my writing.
5. Check and improve the content of my writing.
6. Check and improve the grammar of my writing.
7. Write a homework assignment or paper.

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