

Artificial Intelligence and Input Enhancement in L2 Writing: Theoretical and Pedagogical Insights

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Abstract: With the widespread application of generative artificial intelligence in the field of language teaching, second language writing instruction is gradually transitioning toward digitalization and intelligentization. Traditional input enhancement, which relies on manual operations, is monotonous in form and hardly adaptable to the individual differences of learners; it can no longer meet the dynamic needs of second language acquisition in the digital age. Thus, exploring an AI-driven input enhancement model has become a key issue for optimizing L2 writing instruction. This research focuses on the impact of AI input enhancement on students' English writing. As a digital extension of traditional input enhancement, it relies on tools like ChatGPT, Grammarly, and Bing tools, and is theoretically grounded in second language acquisition theories such as the Input Hypothesis, Noticing Hypothesis, and multimodal learning theory. Guided by these theories, it strengthens target language salience through real-time feedback and integrates multimodal resources (text, images, etc.) to construct immersive learning environments, laying a theoretical basis for subsequent research and practice. To validate this approach, existing studies validate it with three paradigms (theoretical speculation, empirical research, mixed methods), each with pros and cons. In practice, AI input enhancement boosts writing efficiency and student confidence while adapting to diverse teaching scenarios. However, it also brings problems such as students' over-reliance on technology, impaired writing originality, controversies over educational equity, insufficient contextual adaptability of tool feedback, and a lack of guidance for higher-order thinking. To address these issues, future efforts should explore differentiated tool-use rules, optimize tool contextual adaptability, and establish an "AI tools+teacher guidance" collaborative model to balance technology empowerment and student autonomy in L2 writing teaching.

Keywords: AI input enhancement; Second language writing; Input Hypothesis

Online publication: November 14, 2025

1. Introduction

1.1. Empowerment of SLA by AI

Generative Artificial Intelligence is a technology that uses machine learning models to learn patterns and

connections from datasets of content created by humans, and then generates new content such as text, images, audio, and video ^[1]. GenAI technology, with ChatGPT as a typical representative, has shown profound application potential in the field of language teaching and learning, and is promoting significant changes in this field.

Existing studies have adopted qualitative analysis methods to systematically explore the effect of GenAI chatbots on SLA ^[2]. Specifically, the advantages of GenAI in assisting L2 learning are mainly reflected in three aspects: first, it can provide real-time feedback on learners' input information, helping learners find and correct language errors in a timely manner; second, it can simulate real dialogue scenarios, creating a practical language environment for learners; third, it can adapt to the differentiated needs of learners and provide personalized support based on individual learning characteristics.

Quantitative studies have further revealed that the language learning model with AI technology makes learners' writing skills and motivation much better. This is shown in many ways — their ability to organize article structure, make content coherent, use correct grammar, and have richer vocabulary all get better. In addition, through three main functions: real-time feedback, personalized adaptation, and emotional support, AI provides strong support for L2 writing ^[1]. Data show that more than 80% of learners in the experimental group reduced their Foreign Language Anxiety (FLA) with the help of AI, 75% of learners improved their learning attitudes through self-directed learning experiences, and the sense of accomplishment brought by “perceived immediate progress” effectively enhanced motivation, forming a positive cycle for the improvement of L2 writing ability.

1.2. Limitations of traditional teaching approaches

In traditional teaching scenarios, teachers are the core guides for learners' language acquisition. However, the popularization of the Internet has completely changed this pattern.

A comparison between the traditional teaching model and the AI-assisted model highlights the inherent shortcomings of the former. In traditional classrooms, EFL learners tend to experience anxiety when completing writing tasks, and this negative emotion has an adverse impact on their writing performance and learning motivation ^[3]. At the same time, the lag and generality of teachers' feedback in traditional teaching make it difficult to meet learners' needs for timely guidance; moreover, over-reliance on teachers may restrict the development of learners' independent inquiry abilities. In addition, some studies point out that although GenAI has significant advantages in writing guidance, the lack of cultivation of learners' critical thinking in the traditional teaching model is likely to lead to learners' over-reliance on GenAI tools in subsequent use, thereby hindering the development of their independent thinking abilities.

1.3. Definition of AI input enhancement

To clarify AI Input Enhancement, we first look at the theoretical origin of “Input Enhancement.” This concept was put forward by Sharwood Smith (1993). Its main idea is to use external methods to make target features (e.g., grammar, collocations) easier to notice. It guides learners to focus on key elements, helping turn input into “intake” ^[4].

In traditional SLA research, Input Enhancement is mostly manual, following “passive reinforcement + single form” (e.g., bolding collocations in texts). It relies on researchers/teachers' subjective judgment (failing to fit learner differences) and uses single carriers (text/audio), unable to meet digital learning's dynamic, multi-

sensory needs.

AI Input Enhancement is a digital extension and technical upgrade of the traditional Input Enhancement theory. Traditional Input Enhancement is an input optimization method led by humans, with a single form and passive reinforcement. AI Input Enhancement, however, is an innovative input method driven by AI, with multiple forms working together and active adaptation. Its core is optimizing the selection, presentation, and processing of input features through intelligent handling.

Both types of Input Enhancement follow the core logic of making features more noticeable and helping turn input into intake. But with technology, AI Input Enhancement solves the shortcomings of traditional Input Enhancement in fitting individual differences, multi-form cooperation, and dynamic adjustment. It better meets the need for efficient input processing in SLA in the digital age.

2. Theoretical foundations of AI input enhancement

2.1. The Input Hypothesis (1980): Focusing on the necessity of comprehensible input

2.1.1. Core theoretical claims

Proposed by Krashen in 1981, the Input Hypothesis is the first theory in the field of SLA that systematically explains the role of input. Its core view can be summarized as follows: the key to SLA lies in exposure to comprehensible input, and the difficulty of the input should be slightly higher than the learner's current level. Here, “i” represents the learner's existing language proficiency, and “+1” represents language materials that are slightly beyond the current level ^[5]. Krashen further pointed out that ideal input should have four characteristics: comprehensibility, interestingness and relevance, non-grammatical sequencing, and sufficient quantity.

In the field of TCFL, Zhu Weijuan conducted empirical observations to verify the applicability of this hypothesis ^[6]. The findings showed that providing Chinese learners with listening materials of appropriate difficulty, such as dialogues containing familiar vocabulary and sentence patterns, and idiom story videos with visual aids, can significantly improve the efficiency of their input absorption. This is consistent with Krashen's emphasis on comprehensible input. Additionally, Bailey and Fahad carried out a case study on Iraqi English learners. They found that when these learners read English novels slightly above their current proficiency level and used bilingual dictionaries to understand new words, their vocabulary size and text comprehension ability gradually improved. This result also confirms the promoting effect of the “i+1” input in SLA ^[7].

2.1.2. Theoretical limitations and implications for this study

In the research on SLA, the Input Hypothesis identifies the core view that input is the prerequisite for language acquisition, but it also has limitations. On one hand, the concept of “i+1” is not clearly defined and is difficult to measure with specific data, so teachers cannot accurately determine the exact “+1” difficulty level that each learner can accept. On the other hand, this theory places too much emphasis on the meaning of input and fails to attach importance to language forms. As a result, some learners, despite being exposed to a great deal of comprehensible language input in immersive teaching, still have problems with inaccurate grammar in what they write or speak.

For AI input enhancement, the value of the Input Hypothesis is mainly reflected in two principles: the input difficulty should be appropriate, and the input quantity should be sufficient. Specifically, AI tools can dynamically assess learners' writing proficiency and generate feedback that matches their difficulty level, such as providing intermediate-level learners with supplementary examples of how to use complex sentence patterns.

In this way, personalized input that meets the “i+1” requirement can be provided to different learners ^[1]. At the same time, AI can also integrate various forms of resources such as text, audio, and images, making the input content more interesting and more closely connected to learning goals, thereby reducing learners’ cognitive load. This is actually an extension of the ideal input characteristics proposed by Krashen in a digital form.

2.2. The Noticing Hypothesis (1990s): Revealing the key role of cognitive regulation

2.2.1. Core theoretical claims

In 1990, Schmidt proposed the Noticing Hypothesis. This hypothesis addresses the limitation of the Input Hypothesis, which overlooks cognitive mechanisms. Its core argument is that “consciously attending to linguistic forms” is a necessary and sufficient condition for converting linguistic input into intake. In other words, learners cannot acquire new linguistic structures through subliminal perception ^[8]. Later, Schmidt further pointed out that noticing is not a single process but consists of two stages: detection and short-term memory rehearsal. Only when learners actively identify the differences between their interlanguage and the target language can linguistic forms be effectively internalized ^[8].

Building on this foundation, Sharwood Smith put forward the concept of Input Enhancement in 1993 ^[4]. This concept advocates using external interventions, such as bolding text, italicizing content, and presenting information at high frequencies, to increase the perceptual salience of target forms, thereby guiding learners to focus on key features. By reviewing relevant literature in 2019, Li Zhiqiang and Li Yongzhong found that the effectiveness of input enhancement has been supported by a number of empirical studies ^[9]. For instance, in English writing instruction, highlighting lexical collocations can reduce learners’ collocation error rates by more than 30% ^[10]. Additionally, when teachers implicitly correct learners’ incorrect expressions through recasts, it can also indirectly prompt learners to notice linguistic forms.

2.2.2. Theoretical limitations and implications for this study

The Noticing Hypothesis clarifies the importance of cognitive regulation in language learning, yet it has two shortcomings. First, the theory focuses more on learners’ passive attention to linguistic forms and fails to fully consider the motivations behind learners’ active attention, such as learning needs and task objectives. Second, traditional input enhancement methods like text annotation mostly rely on a single modality, making it difficult to adapt to the cognitive preferences of different learners. For example, the needs of visual learners differ from those of auditory learners. For research on AI input enhancement, the core value of the Noticing Hypothesis lies in its confirmation of the necessity of “focusing on linguistic forms.” The essence of AI input enhancement is to use technological means to increase the salience of target linguistic forms. For instance, Grammarly marks grammatical errors with red underlines, and ChatGPT highlights differences in lexical collocations through comparative examples. These functions directly reflect the theoretical logic of input enhancement ^[11]. Meanwhile, AI can dynamically adjust the way of enhancement based on the type of learners’ writing tasks: for argumentative essays, it focuses on strengthening logical connectives; for narrative essays, it emphasizes tense consistency. This enables contextualized and personalized attention guidance, which is precisely a breakthrough in addressing the single-modality limitation of traditional input enhancement.

2.3. Multimodal learning theory (2010s): Constructing a “multi-sensory collaboration” input modal

2.3.1. Core theoretical claims

Since the 21st century, with the popularization of multimedia technology, multimodal learning theory has gradually become a research focus in the field of SLA. Its theoretical basis comes from Halliday’s Systemic Functional Linguistics and Kress & van Leeuwen’s Social Semiotics. Kress and van Leeuwen defined “modality” as a regularized resource for meaning construction, including language, images, gestures, sounds, spatial layout, etc.^[12]. They argued that all communicative activities are processes of multimodal collaboration, and different modalities achieve meaning co-construction through complementation, extension, or conflict^[13].

In the field of education, Early et al. pointed out in a special study published in *TESOL Quarterly* that the core value of multimodal teaching lies in two aspects: first, activating multi-sensory channels such as vision, hearing, and touch to improve the comprehensibility of input and memory retention rate; second, integrating learners’ cultural backgrounds and life experiences to promote in-depth connections between language forms and meanings^[14]. For example, Ajayi conducted a study on ESL students in American junior high schools and found that when learners were asked to interpret mobile phone advertisements through multimodal methods (such as drawing, written explanations, and in-class presentations), their text analysis ability was significantly improved. Moreover, this practice also prompted learners to connect the language forms in the advertisements with their own community experiences (e.g., using red to mark elements symbolizing gang violence), realizing the personalized meaning construction of language input^[15].

Combining the practice of English teaching in China, Wang Chunlei and Li Chili proposed a three-dimensional interaction model for multimodal classrooms. Before class, teachers conduct multimodal lesson preparation (e.g., sharing video courseware and audio lesson plans) and students conduct multimodal preview (e.g., group audio discussions and image annotations) through online platforms^[13]. During class, students solve preview problems through multimodal collaboration among peers (e.g., film dubbing and multimodal reports) and multimodal interaction between teachers and students (e.g., micro-lecture explanations and gesture feedback). After class, the continuity of input is achieved through the interaction between offline and online classrooms (e.g., online inquiries and offline Q&A sessions). This model has verified the significant role of multimodal input in improving classroom participation and learning efficiency.

2.3.2. Theoretical limitations and implications for this study

While multimodal learning theory has expanded the formal boundaries of input, current research still has a focus on description rather than application. On one hand, most studies concentrate on the impact of multimodality on reading comprehension and listening, with insufficient attention paid to productive tasks such as writing^[16]. On the other hand, the integration of multimodal resources lacks systematicity, which easily leads to “modal overload” and instead increases learners’ cognitive load^[17].

For research on AI input enhancement, the guiding significance of multimodal learning theory is reflected in three aspects. First, AI can integrate multimodal resources such as text, images, and audio to achieve input enhancement. For example, Bing Image Creator converts writing topics into visual images to help learners build content frameworks; Bing Chat supplements audio interpretations of cases across multiple fields to strengthen the support for arguments^[18]. Second, AI can dynamically adjust the way of enhancement by analyzing learners’ modal preferences, for instance, some learners prefer visual cues while others prefer auditory feedback, thus

avoiding modal overload. Third, AI can record learners' multimodal outputs, such as writing drafts, drawing annotations, and audio reflections, to build an "input-output" closed loop. This helps teachers and learners track the internalization process of linguistic forms, and it is precisely the digital implementation of the core propositions of "meaning co-construction" and "contextual adaptation" in multimodal theory.

The research on AI input enhancement is a continuation and innovation of this evolutionary trend. Based on the difficulty adaptation principle of the Input Hypothesis, it uses AI's personalized assessment to achieve an accurate supply of "i+1" input. With the focus on form as the core, it optimizes the salience of target language forms through technical means. Taking the multi-sensory collaboration of multimodal theory as the path, it integrates digital resources to build a diversified input model. This provides a systematic theoretical framework for analyzing how AI optimizes the input link in English writing.

3. Pedagogical applications and effectiveness

In the field of SLA research, Input Enhancement serves as a key intervention method to guide learners' attention to language forms. Its research path has always centered on the core question of "how to promote language acquisition through input design." Existing literature explores the mechanism and practical effects of Input Enhancement from different dimensions, mainly through three paradigms: theoretical speculation, empirical research, and mixed methods research. These three paradigms complement each other while having significant differences in research objectives and methodological logic, jointly forming the methodological system of Input Enhancement research.

Theoretical speculation is based on language acquisition theory and semiotic theory. It focuses on the rationality and mechanism of Input Enhancement and provides a framework for empirical research. From the perspective of SLA theory, the Input Hypothesis (Krashen, 1981) and the Noticing Hypothesis (Schmidt, 1990) are the core theoretical supports for Input Enhancement research. Starting from these hypotheses, Li Zhiqiang points out that input enhancement, through prominent designs at the visual or semantic level (such as underlining and bolding), can guide learners to allocate limited cognitive resources to target language forms, thereby promoting the construction of connections between form and meaning^[9, 19]. This view provides a theoretical basis for the attention-guiding function of input enhancement and explains why enhancement designs are often used in the teaching of formal aspects such as grammar and vocabulary.

The introduction of multimodal semiotic theory has further enriched the theoretical dimension of Input Enhancement. By analyzing the process of L2 learners' interpretation of multimodal texts, Ajayi proposes that Input Enhancement should not be limited to a single text modality^[15]. Instead, it should construct a more comprehensive language cognitive framework through multimodal collaborative enhancement, such as "text+image" and "text+audio." For instance, in English vocabulary teaching, combining text bolding (visual enhancement) of target vocabulary with synchronized pronunciation audio (auditory enhancement) can help learners establish connections between the form, sound, and meaning of vocabulary simultaneously. In his research on English classroom reconstruction, Wang Chunlei further points out that the development of AI technology has made multimodal input enhancement possible. For example, intelligent teaching platforms use dynamic animations to enhance the application scenarios of grammatical rules, combining abstract language forms with specific contexts^[13]. This is consistent with the view that "modal diversity promotes language acquisition" in *TESOL Quarterly* (2015) and also provides a theoretical direction for the technical application

of input enhancement in real learning scenarios. For example, they only infer the effectiveness of enhancement through the Noticing Hypothesis but fail to explain the differences in learners' preferences for enhancement modalities (e.g., visual learners vs. auditory learners), leading to a certain disconnect between theoretical conclusions and practical needs.

Empirical research focuses on quantitative analysis. Through rigorous experimental design and data statistics, it establishes a clear connection between Input Enhancement and SLA effects, with the advantage of objective and verifiable conclusions. In the study on the correlation between Input Enhancement types and vocabulary acquisition, Zhou Rong and Lü Lishan adopted a 2×2 between-subjects experimental design, with visual enhancement (with/without underlining) and task involvement load (high/low) as two independent variables^[20]. They quantified the effects of form and meaning acquisition of vocabulary collocations through immediate and delayed tests. The results showed that the vocabulary form mastery score of the enhanced group (M=8.63) was significantly higher than that of the non-enhanced group (M=7.80), and this effect was more prominent in high-involvement tasks ($t=2.486$, $P=0.016$). This study is the first to confirm through empirical data that the promoting effect of input enhancement on vocabulary form acquisition is regulated by task cognitive load, providing quantitative evidence for the task adaptability of input enhancement. In the research on grammar teaching, Wong compared the differences of effects between visual enhancement (bolding) and semantic enhancement (contextual explanation with example sentences)^[21]. He found that visual enhancement was more effective in grammar form memory (e.g., tense rule recognition), with a 21% increase in accuracy, while semantic enhancement was more advantageous in grammar meaning understanding (e.g., pragmatic differences of tenses). This empirical conclusion provides specific guidance for the selection of enhancement types under different teaching objectives.

The rise of AI technology has promoted the development of empirical research on Input Enhancement towards a more refined direction. In their meta-analysis of GenAI chatbots, Li et al. integrated 41 sets of empirical data and found that the overall effect size of GenAI tools with input enhancement functions (such as ChatGPT's highlighting of target sentence patterns) on SLA was 0.576 (95% CI=[0.385-0.768]), and enhancement modalities (with an effect size of 0.751 for text + audio enhancement) had a significant regulatory effect on the effect size^[22]. This result provides systematic empirical support for the effectiveness of input enhancement in the AI era.

Through the combination of quantitative and qualitative methods, the mixed methods research paradigm comprehensively reveals the operation process of input enhancement and learners' cognitive feedback. In the research on AI-assisted writing, Yan adopted a mixed method of classroom observation, learning logs, and in-depth interviews to explore the impact of ChatGPT's input enhancement (real-time marking of writing errors) on L2 learners. Quantitative data showed that the writing error rate of learners using the enhancement function decreased by 32%. Qualitative interviews further revealed that learners believed that enhancement not only helped them quickly locate grammatical problems but also improved their self-correction ability through classified marking of error types (e.g., tense errors, collocation errors). This conclusion not only quantifies the effect of input enhancement but also explains the cognitive mechanism behind the effect, making up for the lack of explanation in pure empirical research on "why it is effective." In their research on AI writing tools, Roe et al. combined questionnaire surveys and text analysis to quantify learners' acceptance of input enhancement (78% of learners recognized the auxiliary value of enhancement). At the same time, by comparing the text characteristics before and after enhancement, they found that the text fluency (e.g., sentence cohesion

score) of the enhanced group increased by 18%. The combination of attitude data and text data provides more comprehensive evidence for the practical applicability of input enhancement.

In summary, the three paradigms of theoretical speculation, empirical research, and mixed methods research have promoted the research progress of input enhancement in SLA from different dimensions: theoretical speculation provides a framework orientation, empirical research establishes quantitative connections, and mixed methods research achieves an in-depth explanation.

4. Challenges and controversies

In the research field of the impact of AI input enhancement on students' English writing, existing studies have formed two main camps regarding technology-enhanced input: one in support and the other in doubt. The core of the controversy focuses on the balance between technology empowerment and learning autonomy, as well as the definition of the boundaries of tool use.

4.1. Perspectives in support of AI input enhancement

The supporting camp believes that AI input enhancement tools significantly promote students' English writing learning by optimizing input forms, improving feedback efficiency, and meeting personalized needs. Their core advantages are reflected in three aspects: efficiency improvement, confidence building, and multi-scenario adaptability.

Regarding efficiency improvement, the input enhancement functions of AI tools can reduce learners' cognitive load and the time cost of non-core tasks. O'Neill and Russell's study on Grammarly found that DWAs can quickly identify grammar errors and vocabulary collocation problems in writing [24]. This allows learners to avoid spending excessive energy on self-correcting basic language errors and instead allocate more cognitive resources to higher-order writing tasks such as content ideation and logical organization. Similarly, Liu et al. pointed out that ChatGPT can generate structured texts (such as argumentative essay frameworks and PPT outlines) and image description texts, while Bing Chat can supplement real-time academic literature and cross-field cases (such as AI applications in healthcare and manufacturing) [18]. The combination of the two can increase the efficiency of students' material collection and framework construction in the pre-writing stage by about 40%, effectively shortening the cycle from "starting from scratch" to completing the first draft. This view is supported by Lai's empirical research. His study showed that the experimental group using AI input enhancement tools had an average 28% reduction in the time to complete the first draft compared to the traditional teaching group, and their text structure integrity scores were significantly higher ($M=8.21$ vs $M=6.73$) [25]. These studies, from the dual perspectives of task completion efficiency and cognitive load optimization, have fairly well verified the practical value of AI input enhancement in English writing learning and provided empirical support for technology-assisted writing teaching. In terms of short-term task effectiveness, O'Neill and Russell's study on Grammarly, Liu et al.'s analysis of the collaborative application of ChatGPT and Bing Chat, and Lai's experiment on low-intermediate English as a Foreign Language (EFL) learners all quantified the advantages of AI input enhancement in reducing the time spent on basic language correction and accelerating writing framework construction through specific data (such as error location speed, the proportion of first draft completion time reduction, and the increase in text structure integrity scores). They clearly demonstrated the optimization effect of technology on the writing process, echoing Law's conclusion in

the review of GenAI language teaching applications that “AI can improve language learning efficiency through real-time feedback and structured output”, and further strengthening the research consensus on the efficiency dimension ^[26].

From the perspective of confidence building, AI input enhancement tools can effectively alleviate learners’ Foreign Language Anxiety and enhance writing confidence through real-time feedback and non-judgmental support. Biju et al.’s quasi-experimental study showed that more than 80% of the learners in the experimental group believed that the grammar correction, structure optimization suggestions, and alternative expression recommendations provided by ChatGPT reduced their concerns about “being judged for mistakes”, with an average decrease of 1.8 points (out of 5) in the writing anxiety scale score ^[1]. Seventy percent of the learners reported that the “perceived immediate progress” brought by AI tools (such as quickly correcting grammar errors and receiving positive feedback) significantly enhanced their writing self-efficacy. Lai further pointed out that AI tools have a more obvious effect on enhancing the confidence of low-intermediate EFL learners ^[25]. After using tools such as Grammarly and QuillBot, this group’s language self-efficacy (such as confidence in vocabulary and grammar accuracy) scores increased by 23%, and their performance self-efficacy (such as confidence in completing writing tasks) scores increased by 19%. Existing studies have deeply revealed the emotional value of AI enhancement in the process of English writing information construction, providing important references for understanding how technology alleviates writing anxiety and optimizes the information processing mindset. Biju et al. found through a quasi-experimental study that more than 80% of the learners in the experimental group had reduced concerns about “being judged for mistakes” due to ChatGPT’s real-time feedback, and their foreign language anxiety scale scores decreased significantly. This is consistent with Lai’s research conclusion on low-intermediate EFL learners. After using AI tools, this group’s language self-efficacy and performance self-efficacy both increased significantly. These studies focused on the changes in emotional states during the information construction process, recognizing the promoting effect of anxiety alleviation on learners’ active engagement in core tasks such as information integration and logical organization. This is consistent with Law’s view in the review of GenAI language teaching applications that “AI can create a safe learning environment through non-judgmental feedback”, enriching the research connotation of AI input enhancement in the dimension of emotional support.

Regarding multi-scenario adaptability, AI input enhancement tools can provide diverse input forms to meet the needs of different writing tasks and learning scenarios. Liu et al. found that in multimodal writing tasks, the image descriptions generated by ChatGPT can serve as effective cue words to assist Bing Image Creator in generating visual materials that fit the theme, enabling the text and images to complement each other in meaning and enhancing the multimodal expression effect of writing. In traditional argumentative essay writing, AI tools can help students build a coherent logical framework by generating “transition texts” (such as definitions and background knowledge). Roe et al. also mentioned that the “style switching function” (such as the conversion between academic and colloquial styles) of tools like Wordtune can provide learners with language input references for multiple scenarios, expanding the application boundaries of the target language.

4.2. Perspectives questioning AI input enhancement

The questioning camp argues that excessive use of AI input enhancement tools may lead to weakened learning autonomy, a lack of educational equity, and impaired writing originality.

Regarding technology dependence, some studies point out that over-reliance on AI input enhancement

tools will weaken learners' independent thinking and language internalization abilities. A survey by Roe et al. shows that 37.5% of students, after long-term use of Automated Paraphrasing Tools, developed the behavior of "directly copying and slightly adjusting AI-generated content", which reduced their independent thinking about argument ideation and sentence pattern innovation. Approximately 60% of learners admitted that they adopted AI's grammar correction suggestions without analysis, resulting in a superficial understanding of language rules and difficulty in developing independent language judgment abilities. A qualitative study by Yan also found that some learners gradually lost the ability to independently construct text frameworks when using ChatGPT to assist writing. Without AI tools, their scores on writing logical coherence decreased by 25%.

In terms of writing originality, some studies believe that AI input enhancement tools may lead to the homogenization of writing content and weaken learners' personalized expression. Garg points out that texts generated by ChatGPT mostly follow fixed logical frameworks and expression patterns ^[27]. If learners over-rely on the arguments and sentence patterns it provides, their writing will lose personal style and present a phenomenon of "all texts looking alike." Approximately 37% of learners report that revisions suggested by AI often make the text "too formal or generic", failing to accurately convey their true intentions. A teacher-perspective study by Marzuki et al. also found that the scores of students' writing using AI tools in content originality and viewpoint uniqueness were 18% lower than those of the traditional teaching group, and the frequency of "AI-characteristic expressions" (such as fixed sentence patterns and common arguments) in the texts was significantly higher ^[28].

5. Future directions: Balancing technology empowerment and learning autonomy

By synthesizing the supporting and questioning perspectives, it can be concluded that the impact of AI input enhancement on students' English writing is not absolute (i.e., neither entirely positive nor negative). The realization of its value depends on defining the boundaries of reasonable use and promoting collaboration between technology and teaching, with the core lying in balancing technology empowerment and learning autonomy.

In terms of defining usage boundaries, it is necessary to guide learners to use AI input enhancement tools critically through clear rules and scenario restrictions. Roe et al. propose that the application scenarios and scope of tools should be clearly defined ^[23]. For example, ChatGPT should be limited to "pre-writing idea inspiration"—such as generating multi-dimensional argument references—rather than direct replacement during writing. Learners are required to compare the differences between AI-generated texts and their own texts, and analyze the advantages and disadvantages of each. For the use of Automated Paraphrasing Tools, rules should stipulate that they "can only be used to optimize personal expression" to avoid plagiarism and intellectual laziness. Lai also suggests that teachers can design a "double-draft comparison" task: students are required to complete the first draft independently first, then revise it using AI tools, and submit both drafts along with an explanation of revisions ^[25]. This task guides learners to actively reflect on the rationality of AI feedback and cultivates their ability to make critical choices. This "rule + task" approach not only exerts the input enhancement function of AI tools but also maintains learning autonomy through the reflection process. However, further research is still needed on how to formulate differentiated usage rules based on learners' proficiency levels (e.g., beginner vs. advanced EFL learners).

At the level of collaboration between technology and teaching, a cooperative model of "AI tools+teacher

guidance” can be established to make up for AI’s shortcomings in cultivating higher-order thinking. Biju et al. point out that AI tools are highly effective in enhancing surface-level input, such as grammar and structure, but they have limitations in providing input support for higher-order writing thinking. Therefore, teachers need to supplement input related to higher-order thinking through in-class explanations, group discussions, and other methods—for instance, guiding students to analyze the novelty of arguments and the rigor of logic—to prevent learners from developing intellectual laziness due to over-reliance on AI. Namaziandost et al. also emphasize that teachers should guide learners to pay attention to the linguistic features highlighted by AI and promote the internalization of these features through exercises (such as imitative sentence-making), rather than allowing learners to passively accept AI suggestions. This collaborative model integrates the efficiency advantages of technology and the educational value of teachers, but it places high demands on teachers’ AI literacy—such as understanding the principles of AI tools and guiding students in tool use. How to improve teachers’ ability to integrate AI through training has become a key challenge for the implementation of this model.

6. Conclusion

Through a systematic review of literature on the impact of AI input enhancement on students’ English writing, this study integrates the evolution of SLA theories, the comparison of research paradigms, and the analysis of practical applications. It initially clarifies the research status, core value, and unsolved problems in this field, and also provides directional references for the optimization of L2 writing teaching in the AI era.

From a theoretical perspective, the development of the Input Hypothesis, Noticing Hypothesis, and multimodal learning theory in SLA has provided solid support for the rationality and effectiveness of AI input enhancement. The principle of comprehensible input and “i+1” difficulty adaptation emphasized by the Input Hypothesis is reflected in the process where AI tools dynamically assess learners’ proficiency and generate gradient feedback. The Noticing Hypothesis, which claims that “attention to language forms is a necessary condition for input internalization”, is verified by AI tools that enhance the salience of target language features. The “multi-sensory collaboration” advocated by multimodal learning theory is also implemented in practice, where AI integrates resources such as text, images, and audio to build an immersive input ecosystem. These three theories together form the theoretical foundation of AI input enhancement, revealing that its essence is the extension and innovation of traditional input enhancement in the digital age.

In terms of research methods, the three major paradigms: theoretical speculation, empirical research, and mixed methods research, each have advantages and disadvantages. From the perspectives of SLA theory and semiotics, theoretical speculation provides logical explanations for the mechanism and value of AI input enhancement, but it mostly relies on deduction from existing theories and lacks attention to real teaching scenarios. Through experimental design and data statistics, empirical research quantitatively confirms the positive effects of AI input enhancement on improving writing accuracy, structural integrity, and reducing learning anxiety. However, most studies have limitations such as short research cycles and single data dimensions. Mixed methods research combines quantitative and qualitative approaches to both quantify the effect of tool use and explore learners’ cognitive feedback, but it faces problems such as insufficient logic in method integration and researchers’ subjective bias. Future research needs to promote the collaboration of these three paradigms, strengthen the connection between theory and practice, and expand research cycles and data dimensions.

From the perspective of practical application, AI input enhancement shows significant advantages in improving writing efficiency, building learning confidence, and adapting to multi-scenario needs. It reduces the time spent on correcting basic language errors through real-time feedback, helping learners focus on higher-order writing tasks; its non-judgmental feedback reduces foreign language anxiety and improves self-efficacy; and multimodal tools adapt to different writing tasks. However, problems such as the risk of technology dependence and impaired writing originality have also become prominent. In addition, limitations of AI feedback—such as insufficient contextual adaptability and lack of guidance for higher-order thinking—need to be addressed through the collaborative model of “AI tools + teacher guidance”: tools should strengthen scenario adaptation and logic verification functions, while teachers should guide learners to use tools critically and cultivate their higher-order writing thinking.

In summary, AI input enhancement provides a new path for L2 writing teaching, but the realization of its value requires defining reasonable boundaries for use and promoting collaboration between technology and teaching. Future research can further explore differentiated rules for tool use, optimize AI’s contextual adaptability, and deepen the cultivation of teachers’ AI literacy. This will not only give play to the role of technology empowerment but also ensure learners’ independent thinking and ability development, promoting the scientific development of L2 writing teaching in the AI era.

Funding

This paper is financially supported by the 14th Five-Year Plan Key Project of Hunan Provincial Education Science (Changsha, CN) under Grant number XJK23AGD003.

This paper is also financially supported by the Independent Research and Innovation Project for Graduate Students of Central South University, with the project number 2025ZZTS0382.

Disclosure statement

The authors declare no conflict of interest.

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