e-ISSN: 2723-7095 DOI. https://doi.org/10.32627/jepal.v7i1.2041

Vol. 7, No. 1, Tahun 2026, pp. 92-108

JEPAL

Journal of English Pedagogy and Applied Linguistics

https://www.jurnal.masoemuniversity.ac.id/index.php/englishpedagogy

Submitted: 10 May 2026 Revised: 25 July 2026 Accepted: 1 August 2026 Available Online: 1 August 2026

HUMAN–AI COLLABORATION IN EFL WRITING: A CONCEPTUAL FRAMEWORK FOR INTELLIGENT FEEDBACK SYSTEMS

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Abstract: Artificial intelligence (AI) has increasingly been integrated into English as a Foreign Language (EFL) writing instruction, offering new opportunities to improve students' writing through automated and intelligent feedback. Nevertheless, existing studies remain fragmented and predominantly emphasize the technological capabilities of AI tools rather than their pedagogical integration within classroom practice. This study aims to synthesize recent literature and propose a conceptual framework for human–AI collaboration in EFL writing by integrating technological, pedagogical, and learner-centered perspectives. Employing a qualitative library research design, the study systematically reviewed peer-reviewed journal articles published between 2016 and 2026. Data were collected from Google Scholar, Scopus, ERIC, and ScienceDirect and analyzed using thematic analysis involving coding, categorization, and theme development. The findings reveal three interrelated components of effective AI-assisted writing instruction: AI as an intelligent feedback provider, teachers as pedagogical scaffolding agents, and students as self-regulated learners. These components interact dynamically to support writing development, strengthen learner autonomy, and promote meaningful engagement with feedback. The review also identifies several pedagogical challenges, including learners' overdependence on AI-generated feedback and limited critical engagement with automated suggestions. The study concludes that effective AI integration in EFL writing requires a balanced collaboration between technological support and pedagogical guidance, grounded in constructivist learning theory, self-regulated learning, and feedback literacy. The proposed conceptual framework contributes to the theoretical foundation of AI-assisted language learning and provides practical implications for integrating intelligent feedback systems into EFL writing instruction.

Keywords: artificial intelligence, EFL writing, human–AI collaboration, intelligent feedback systems, self-regulated learning

INTRODUCTION

Artificial intelligence (AI) has rapidly changed educational practice across various fields, including English as a Foreign Language (EFL) instruction. Recent breakthroughs in artificial intelligence technologies have opened new possibilities for supporting language acquisition by offering automatic, instantaneous and individualized feedback. Luckin et al. (2016) suggested that intelligent educational technologies can customize instructional content and feedback to individual learners' requirements thereby providing more tailored educational experiences than traditional classroom feedback, which is uniform for all students. Nazari et al. (2021) conducted a randomized controlled trial with non-native postgraduate students, and also found that the use of an AI-powered digital writing assistant had a positive effect on students' cognitive, non-cognitive and emotional engagement with academic writing, suggesting that AI-based feedback can be an efficient assist-writing tool. AI applications in EFL writing instruction, such as Automated Writing Evaluation (AWE) systems and generative AI tools, allow learners to identify language errors, revise their writing several times, and receive timely feedback during the writing process (Warschauer & Grimes, 2008; Ranalli, 2021). For example, in a study conducted at many schools, Warschauer and Grimes (2008) found that AWE software users revised their essays more frequently than non-users, although these revisions were mostly restricted to surface-level language forms rather than to substance or organization. These technologies have therefore drawn increased interest from educators and academics as viable instructional tools to improve writing quality and address practical issues of traditional feedback procedures.

Writing is widely recognized as one of the most challenging language skills for EFL learners because it requires the use of linguistic knowledge, critical thinking, organization and rhetorical competence, with discourse-level skills, such as the organization and integration of ideas into cohesive and coherent text, being among the most difficult aspects of language use to master, for foreign-language and native writers alike (Nunan, 1989; Dewi et al., 2023). Students should be able to write grammatically correct sentences, as well as organize their ideas, write effectively to specific audiences, and update their writing through several steps of preparation, drafting, editing, and reflection. Feedback is essential to enhance writing development throughout this complex learning process. Teacher feedback is traditionally regarded as the most helpful instructional support because it presents contextualized explanations, fosters higher-order thinking, and helps learners improve the quality of their language as well as subject . However, due to large class sizes, limited instructional time, and teachers' busy workloads, delivering timely and personalized feedback continues to be difficult in many EFL classrooms (Carless & Boud, 2018).

Artificial intelligence systems, unlike traditional feedback, can provide rapid, consistent, and individualized feedback that can help learners modify their writing more effectively and strive for continual development. Previous research have demonstrated that AI-generated feedback is beneficial for learners' grammatical accuracy, vocabulary

development, motivation and engagement in the writing process (Ranalli, 2021; Kohnke et al., 2023). In addition, AI-supported learning environments foster learner autonomy, allowing students to revise autonomously through several rounds of feedback, so supporting self-directed learning and reflective writing habits.
But artificial intelligence can't be considered a whole replacement for teachers. Modern artificial intelligence (AI) systems are mostly designed to help with basic linguistic features like grammar, spelling, vocabulary, and sentence structure, with somewhat limited support for more complex writing skills like argumentation, critical thinking, rhetorical awareness, and audience consideration. Also, AI-generated feedback can sometimes be wrong or contextually unsuitable, so learners need to critically examine and interpret the feedback before incorporating it into their writing. Hence, significant writing improvement is not only reliant on technology aid but also on pedagogical assistance from teachers and active engagement from learners during the revision process (Widianingtyas et al., 2023).

From a pedagogical point of view, the effectiveness of AI-assisted writing can be better understood through constructivist learning theory, self-regulated learning (SRL), and feedback literacy. Constructivism stresses that knowledge is constructed by the learners themselves via interaction, reflection, and meaningful experiences, instead of being passively received. Similarly, self-regulated learning is defined as the capability of students to plan, monitor, assess, and control their own learning processes (Panadero, 2017). In AI-assisted writing environments, students should use automated feedback as a tool for reflection and modification rather than passively accepting ideas. Also, feedback literacy refers to learners' ability to perceive, analyze and use feedback effectively to improve their future performance (Carless & Boud, 2018). Taken together, these theoretical approaches show that standard artificial intelligence may facilitate writing growth when situated within pedagogically meaningful learning contexts that foster learner autonomy and critical engagement with feedback.

Although research in AI-assisted writing has grown tremendously in recent years, important gaps remain. Most existing studies have focused on the effectiveness of individual AI applications in enhancing writing performance, while relatively little attention has been given to understanding how standard artificial intelligence can be embedded into pedagogical practice through meaningful collaboration among teachers, learners and intelligent technologies. Furthermore, past research tends to focus on AI-generated feedback, teacher feedback, or peer feedback in isolation, without any discussion of how these complementing types of feedback interact to assist writing development. Another shortcoming is the absence of theoretical integration between constructivism, self-regulated learning, and feedback literacy, resulting in limited knowledge of the pedagogical mechanisms involved in AI-assisted writing instruction. To fill these gaps, the current study reviews recent literature on AI-assisted EFL writing and presents a conceptual framework for human-AI collaboration by incorporating technological, pedagogical, and learner-centered approaches. Specifically, the study investigates the functions of AI-generated feedback, instructor scaffolding and students'

self-regulated learning in facilitating writing development using intelligent feedback systems. Based on constructivist learning theory, self-regulated learning and feedback literacy, this study aims to offer a more holistic theoretical foundation for AI-assisted writing instruction and practical implications for educators seeking to implement artificial intelligence (AI) tools effectively in EFL classrooms.

LITERATURE REVIEW

Intelligent Feedback Systems in Language Learning

According to this study, intelligent feedback system refers to AI-based educational systems that utilize machine learning and natural language processing to analyze student input and provide tailored, adaptive responses with limited direct human mediation (Van Lehn, 2011). Intelligent feedback systems, unlike static, rule-based feedback systems, are developed to approximate aspects of learner performance and to change the content and level of scaffolding they deliver accordingly (Holmes et al., 2019). Intelligent feedback systems within the framework of EFL writing include Automated Writing Evaluation (AWE) programs and generative AI tools that combine natural language processing with adaptive algorithms to detect linguistic errors, evaluate discourse-level features such as coherence and organization, and generate feedback that approximates certain functions of human tutoring (VanLehn, 2011; Zawacki-Richter et al., 2019). In a meta-analysis of tutoring research, VanLehn (2011) found that intelligent tutoring systems can approximate the effectiveness of human tutors under some conditions, providing a theoretical basis for treating intelligent feedback systems as pedagogically meaningful instructional agents rather than as simple digital stand-ins for teacher feedback. By framing AI-generated feedback within this broader concept, it becomes clear why such tools are examined in the present study not simply as software features, but as intelligent instructional agents whose feedback interacts with teacher scaffolding and learner self-regulation within the proposed conceptual framework.

Artificial Intelligence in EFL Writing

Artificial intelligence (AI) has become one of the most remarkable technological breakthroughs in language education, especially in the teaching of English as a Foreign Language (EFL) writing. Recent progress in machine learning, natural language processing (NLP), and generative AI has enabled intelligent writing systems to deliver automated, immediate, and individualized feedback that guides learners throughout the writing process. Modern AI writing assistants can spot language problems, suggest better vocabulary, evaluate sentence structures and provide input on coherence and organization, unlike traditional digital grammar checkers. Therefore, AI has been more and more regarded as a good instructional tool to improve learners' writing ability and help them with continual rewriting (Nazari et al., 2021; Ranalli, 2021). AI has also addressed some pedagogical problems connected with traditional classroom feedback in EFL writing training. In many educational environments, educators are

often constrained by high class numbers, limited teaching time, and heavy assessment burdens, which limit their capacity to offer prompt and personalized feedback to all students. AI-powered writing tools, in contrast, provide immediate responses that allow students to make revisions on their own before getting teacher input. This continuous engagement with AI-generated feedback enables learners to experience many rounds of revision, resulting in improved accuracy in writing, increased learner engagement, and fostering self-directed learning (Kohnke et al., 2023).

Recent systematic reviews also suggest that AI supports individualized education through tailoring feedback to the particular needs and competence level of the learners (Zawacki-Richter et al., 2019). Generative AI apps have increased these opportunities by giving interactive assistance with writing. Such programs go beyond correcting grammar to include developing ideas, enriching vocabulary, and refining language. Consequently, AI has moved from being a mere evaluation tool to an intelligent learning partner to assist ongoing improvement of writing. However, AI also has severe pedagogical limits. The current artificial intelligence (AI) tools tend to be focused on lower-level linguistic features such as grammar, vocabulary, spelling, and sentence correctness and provide relatively little support for higher-order writing skills such as argumentation, critical thinking, rhetorical awareness, and audience consideration. Moreover, AI-generated feedback may occasionally be incorrect or contextually inappropriate, demanding learners to critically examine ideas rather than passively accepting them. For this reason, contemporary scholars emphasize the importance of AI being used as a complementing teaching tool rather than a replacement for teachers (Zhai, 2022; Widianingtyas et al., 2023). The promise of AI for education hinges not only on its technological competence but also on how it is integrated into effective pedagogical practices.

Human–AI Collaboration in Writing Instruction

The rise of AI in education has altered the academic focus from technology efficiency to human-AI collaboration. Rather than replacing instructors, AI is seen as a collaborative partner that boosts human competence in all stages of the teaching and learning process. In EFL writing instruction, the human-AI cooperation is conceptualized as the dynamic interaction of AI-generated feedback, instructor scaffolding, and learners' active engagement in the processes of writing, revising, and reflecting. Each part has a different yet complimentary purpose. AI provides instant, objective and uniform feedback that enables learners to effectively diagnose language-related issues. Teachers add pedagogical knowledge to evaluate AI-generated feedback, contextualize their explanations, develop critical thinking, and deal with higher-order writing features that are still out of the reach of AI. In the meantime, learners are fully engaged with both sources of feedback by processing ideas, editing drafts and reflecting on their own progress of learning. Then learning becomes a collaborative process in which technology helps efficiency and teachers facilitate meaningful knowledge building.

Other studies have repeatedly shown that students learn more completely when they receive a combination of AI-generated feedback and teacher assistance rather than relying on only one type of feedback. AI improves efficiency of revision by giving instant feedback and teachers promote deeper knowledge, metacognitive awareness and rhetorical skill (Holmes et al., 2019; Kasneci et al., 2023). So, it's not about technology replacing human guidance, it's about the combination of the AI's intellect and the teacher's competence. Despite the increasing interest in human-AI collaboration, the previous literature has mainly focused on evaluating AI performance rather than understanding the pedagogical interactions between teachers, learners, and intelligent systems. Thus, there remains a need for a complete conceptual framework to describe how these three components interact to promote meaningful writing growth in EFL courses.

Feedback in EFL Writing

Feedback has long been acknowledged as one of the most powerful elements in writing development because it enables learners to see the difference between their current performance and intended learning outcomes (Hattie & Timperley, 2007). Feedback in EFL writing is not merely a matter of correcting mistakes, it is a pedagogical tool which fosters reflection, revision and further development during the writing process. Teacher feedback is a critical component of effective writing education as it gives contextualized explanations, addresses higher-order writing abilities, and helps learners to enhance organization, coherence, and argumentative quality. In practice, however, classroom limits often limit teachers' opportunities to offer each learner with precise and fast feedback. AI-generated feedback offers a remedy to this problem by providing instant and customized responses that may be revised repeatedly and offers ongoing writing practice (Ranalli, 2021). However, the usefulness of feedback does not just depend on its source but also on the learners' ability to interpret, analyze, and use the feedback properly. This talent is conceived as feedback literacy, defined as the ability of learners to evaluate feedback critically and use it to improve subsequent performance (Carless & Boud, 2018). Strong feedback literacy learners are more likely to be actively involved in revision, have more metacognitive awareness, and have better writing performance (Zhang et al., 2023). Therefore, successful writing education should integrate instructor feedback with AI-generated input and, at the same time, develop learners' ability to critically analyze both types of feedback.

Constructivism, Self-Regulated Learning and Feedback Literacy

The theoretical foundation of this work is constructivism, self-regulated learning (SRL), and feedback literacy since these approaches together account for how learners interact with AI-assisted writing settings. Learning is viewed as a constructive process in which knowledge is generated via interaction, reflection and meaningful learning experiences rather than being directly conveyed from teacher to student (Constructivism). In EFL writing, learners are continuously drafting, getting feedback,

editing and reflecting to increase their writing skill throughout the writing process. AI-assisted writing environments help this process through quick feedback that prompts learners to actively develop knowledge through iterative revision. Self-regulated learning is closely linked with constructivism, as it emphasizes the learners' ability to design, monitor, regulate and assess their own learning activities in an effort to achieve academic goals (Panadero, 2017). AI-generated feedback can enhance self-regulation by helping learners to detect flaws, track progress and make educated decisions about revision independently. Nevertheless, learners are accountable for critically examining AI proposals and for determining the appropriateness of those proposals in specific writing settings.

Feedback literacy further buttresses this theoretical stance as it explains the ways in which learners interpret and utilize feedback. Carless and Boud (2018) argue that feedback only facilitates learning when students have the capacity to engage with, make sense of and act on the feedback they receive. Therefore, AI-generated feedback by itself cannot ensure improvement in writing. The combination of technical support, pedagogical direction, and learners' active involvement in the writing process results in meaningful learning. Therefore, the convergence of constructivism, self-regulated learning, and feedback literacy provides a holistic theoretical foundation for explaining human-AI collaboration in AI-assisted EFL writing teaching.

METHOD

The project used a qualitative library research design to establish a conceptual framework for human–AI collaboration in EFL writing training. Library research was chosen as the study's goal was to synthesize existing empirical and theoretical findings, rather than to collect primary data from participants. The study aimed at a comprehensive analysis of contemporary literature to uncover common themes, theoretical frameworks, and pedagogical consequences of the use of artificial intelligence in EFL writing teaching. This method is suitable for conceptual studies aiming to synthesize existing knowledge, identify research gaps and/or suggest new theoretical frameworks (Kitchenham, 2004; Snyder, 2019).

The literature search was conducted utilizing four main academic databases, namely Scopus, ERIC, ScienceDirect and Google Scholar. These databases were chosen because they provide a wide coverage of peer-reviewed publications in education, applied linguistics, educational technology and artificial intelligence. The search used a combination of keywords such as artificial intelligence, AI-assisted writing, EFL writing, automated writing evaluation, human–AI collaboration, feedback literacy, self-regulated learning, and constructivism. Only English-language papers published between 2016 and 2026 were evaluated to guarantee the relevance and recency of the studies under examination.

The choice of literature was directed by predefined inclusion and exclusion criteria to improve the credibility of the review process. Studies were included if they (1) examined AI applications for EFL or second language writing, (2) discussed AI-

generated feedback, human–AI collaboration, writing pedagogy, feedback literacy, or self-regulated learning, (3) were published in peer-reviewed journals or reputable academic books, and (4) provided theoretical or empirical evidence relevant to the objectives of this study. Publications were excluded if they only discussed the technical aspects of artificial intelligence without instructional implications, were from fields unrelated to language teaching, or were not sufficiently methodologically and theoretically rigorous.

Data analysis was carried out utilizing thematic analysis approach based on the six phases proposed by Braun and Clarke (2006): familiarising yourself with your data, generating initial codes, looking for themes, reviewing themes, defining and naming themes, and producing the final synthesis. After gathering the relevant papers, the studies were read again to obtain a thorough knowledge of the material. The relevant information was then coded according to recurrent themes and conclusions from the investigation. Similar codes were clustered into larger categories and these categories were synthesized into primary themes that described the pedagogical functions of AI, teachers, and learners in AI-assisted writing instruction. The analysis focused on the correlations identified between AI-generated feedback, instructor scaffolding, self-regulated learning, constructivist learning, and feedback literacy. These interrelated concepts constituted the basis for the suggested conceptual framework.

To enhance the trustworthiness of this study, the review followed a transparent and systematic approach in the processes of literature identification, selection, analysis and synthesis following the criteria of credibility, transferability, dependability and conformability by Lincoln and Guba (1985). Data triangulation was accomplished by comparing findings across different databases, theoretical views and empirical experiments. Instead of depending on single articles, the research combined converging information from many academic sources, thus strengthening the robustness of the proposed framework. To maintain conceptual coherence and analytical rigor, the interpretation of results was constantly contrasted with existing theories of constructivism, self-regulated learning (Panadero, 2017) and feedback literacy (Carless & Boud, 2018).

This study did not include human participants and/or personal data. It was a review of published academic literature. No official ethical approval was necessary. However, ethical research methods were followed by correctly portraying past research, citing all original sources appropriately and adhering to the standards of academic integrity throughout the research process.

FINDINGS AND DISCUSSION

This section contains the findings of the study in which the results and discussion is not done separation. The hope in this discussion the author examines the findings and cross-reference with the study of theoretical and empirical studies.

AI-Based Feedback in EFL Writing

The literature surveyed in this study consistently reports that artificial intelligence has emerged as an increasingly useful teaching resource for assisting the development of writing in English as a Foreign Language (EFL) contexts. The main purpose of AI-powered writing applications in the studies examined is to provide automated feedback to help learners discover language problems, revise their writing drafts, and improve the overall quality of their writing. Unlike the traditional teacher feedback which is typically confined by instructional time and class size, AI-generated feedback is available immediately and continuously, thereby allowing learners to engage in several cycles of revision throughout the writing process.

The investigation found that AI-assisted writing tools were most effective in enhancing lower-order writing skills such as grammar, spelling, punctuation, word choice, and sentence construction. According to Nazari et al. (2021) and Ranalli (2021), learners who receive quick automated feedback tend to write more accurate texts since they are able to identify and repair language problems before submitting the final manuscripts. Similarly, as Kohnke et al. (2023) suggest, AI-supported writing environments provide continual engagement with revision through rapid feedback that motivates repeated practice for learners. AI is a learning partner, not just an assessment tool; it offers formative learning through persistent engagement. AI-generated feedback also helps learner motivation and engagement as well as linguistic accuracy. Immediate responses eliminate the waiting period that often accompanies instructor comments, enabling learners to edit their work while their cognitive focus is still on the activity. This constant contact allows students to become more actively involved in assessing their own learning progress and trying out alternative writing styles.

Therefore, AI-assisted writing environments offer chances for iterative learning, in which writing progress occurs through repeated drafting, feedback, reflection, and editing. These findings support the premise that AI has the potential to allow more learner-centered writing instruction by increasing active engagement rather than passive error correction. Despite these benefits, the literature reviewed frequently underlines the inherent pedagogical limits of AI-generated feedback. Most current artificial intelligence systems only assess surface linguistic aspects and hence give limited help for higher-order writing talents such as idea generation, logical structure, rhetorical awareness, audience consideration, and critical argumentation. While generative AI tools have exhibited a higher ability to make contextual ideas, their feedback may still lack pedagogical sensitivity and may provide recommendations that are wrong, too broad, or contextually inappropriate. Therefore, learners cannot rely solely on AI-generated feedback for the acquisition of comprehensive writing skills.

The results also indicate that the educational effectiveness of AI is highly contingent on the learners' capacity to critically interpret and evaluate the automated feedback. Uncritical acceptance of AI ideas can lead to improved grammatical accuracy but not to the development of independent writing competence or critical thinking skills. Conversely, learners who actively evaluate the input generated by the AI with their own aim of writing display higher metacognitive awareness and more meaningful learning outcomes. This finding is in line with the notion of feedback literacy, which posits that feedback is effective for learning only if learners comprehend, assess and use it effectively (Carless & Boud, 2018). Therefore, AI should be seen not a stand-alone educational solution, but as a learning resource that demands active student interaction.

These findings also lend support to constructivist views of learning. Constructivism holds that knowledge is not something that is transferred immediately from the outside world but rather is actively built via interaction, reflection, and meaningful learning experiences. In AI-assisted writing instruction, learners gain knowledge by making sense of the feedback generated by computers, reflecting on the difficulties revealed, changing their writings, and assessing the success of their adjustments. Thus AI acts as a cognitive scaffold that supports learning, rather than a replacement for learners' own thinking processes. Writing becomes an iterative process whereby feedback leads to contemplation, reflection to revision and revision to ongoing knowledge production.

Pedagogically, the evaluated research collectively show that AI-generated feedback should supplement, rather than replace, teacher feedback. Artificial intelligence can offer immediate, objective and scalable replies, but teachers are still vital in helping address the higher-order parts of writing, such as critical reasoning, structuring of discourse, audience awareness and rhetorical efficacy. Teachers assist learners in making sense of automatic feedback, deciding which ideas are appropriate and which are not, and linking revision decisions to larger learning goals. Therefore, good writing teaching should combine the efficiency of AI feedback with teachers' pedagogical knowledge to provide a more holistic learning environment.

Results show artificial intelligence may significantly improve EFL writing instruction by providing more accessible, immediate, and consistent feedback . Its efficiency, however, depends not just on technological competence but also on pedagogical execution. The educational benefits of AI-assisted feedback are maximized when learners actively interact with feedback, teachers provide instructional scaffolding, and both forms of help are embedded in purposeful writing activities. These findings set the stage for the following discussion on conceptualizing human–AI collaboration as an integrated pedagogical strategy for EFL writing training.

Human–AI Collaboration in Writing Instruction

Thematic analysis reveals that the effectiveness of AI-assisted writing teaching depends not only on the sophistication of artificial intelligence (AI) tools but also on the quality of collaboration between artificial intelligence systems, teachers and learners. The studies examined suggest that AI has great promise to help writing growth through providing rapid and individualized feedback, but meaningful learning takes place only when this technical support is combined with pedagogical direction and active participation of the learners. The findings so suggest that AI should be seen as a partner in collaborative learning rather than as an independent substitute for instruction. The examined research consistently shows that AI and teachers have complimentary roles in the writing process. artificial intelligence systems can detect grammatical faults, lexical issues, sentence structures, and language accuracy easily. At the same time, artificial intelligence systems can provide quick feedback, allowing learners to edit their drafts continually. This immediacy encourages formative learning and gives students feedback when and as needed, rather than waiting for teacher review. This continual contact makes the learners go through several cycles of review, which in turn contributes to writing accuracy and autonomous learning (Nazari et al., 2021; Ranalli, 2021). By comparison, instructors offer educational competence that is not yet present in artificial intelligence (AI) systems. Teachers do more than correct language mistakes. They analyze students' intentions, judge the quality of arguments, explicate context,

stimulate critical thinking, and promote rhetorical awareness. They also assess if the AI-generated prompts are pedagogically acceptable for particular learning goals and classroom settings. These results support the prior claims that human judgment is still needed in language instruction as good writing does not just mean linguistic correctness but also communication, creativity, and critical reasoning (Holmes et al., 2019; Kohnke et al., 2023).

Another key discovery is related to the role of the learners in AI-supported writing environments. Students are encouraged to be active participants in the evaluation of AI ideas, revision decisions, and monitoring of their own writing development, rather than passive users of automated input. Several research in the study highlight that learners who critically engage with AI-generated feedback tend to perform better than those who passively accept automated adjustments. This study suggests that the successful integration of AI relies on students' ability to self-regulate their learning and to use feedback as a resource for reflection rather than as a direct answer to writing issues. The interaction among these three components, AI, teachers and learners, is similar to the ideas of collaborative learning. Rather of functioning independently, each part plays a complimentary role in the creation of writing. AI provides technological efficiency through instant feedback, teachers add pedagogical mediation and instructional scaffolding, and learners engage in reflective revision and self-regulation. Learning, therefore, is the result of ongoing interplay between technology support, human knowledge, and learner agency, rather than the contribution of one aspect of instruction.

This collaborative interaction can also be seen from the perspective of constructivist learning theory. According to constructivism, knowledge is actively built through interaction with learning resources and social contexts. AI-generated feedback is one type of cognitive support in AI-assisted writing education, and teachers can provide deeper comprehension by helping learners comprehend input in meaningful instructional situations. Learners then reflect on comments, revise their work, and assess the success of those adjustments to build knowledge. AI therefore acts as a scaffold to support learning, and teachers aid learners in transforming feedback into meaningful knowledge development.

The results also indicate that self-regulated learning is at the heart of sustaining effective human-AI collaboration. AI-generated feedback offers learners quick insight into how well they are writing, helping them to monitor their progress and discover areas that want work. However, learners retain responsibility for organizing revision procedures, judging automated suggestions, and deciding on suitable changes to their writings. These processes are quite similar to the phases of the self-regulated learning suggested by Panadero (2017): planning, monitoring, controlling, and reflecting.

Thus, AI enhances self-regulation only if learners actively participate in these cognitive processes and do not passively depend on technology aid. Another recurrent topic across the studied literature is the need for feedback literacy as a mediating factor for human–AI collaboration. Feedback is only educationally useful when learners can interpret, analyze and apply it effectively. AI is able to produce contextualized and timely feedback. However, students may misinterpret automated suggestions or implement adjustments without understanding the linguistic principles that underlie the feedback if they lack sufficient feedback literacy. Teachers therefore play a vital role in nurturing students' feedback literacy by promoting critical evaluation, discussion and reflective decision-making across the writing process. This pedagogical support allows learners to integrate automated feedback into meaningful

learning experiences rather than only addressing isolated linguistic faults. All in all, the findings imply that effective AI integration should be conceived as a balanced partnership rather than a technology-driven educational strategy. AI provides speed, consistency and accessibility; teachers give pedagogical experience, contextual judgment and emotional support; and learners actively govern their own learning through reflection and revision. So the educational usefulness of AI is not in replacing human instruction but in increasing the interplay between these complementing elements. This unified approach offers the conceptual foundation for specifying the particular functions of artificial intelligence (AI) systems, educators, and students in AI-supported writing education, which is explored in the next section.

The Roles of AI, Teachers, and Students in AI-Assisted Writing Instruction

The theme synthesis reveals that effective AI-assisted writing education is grounded in the complimentary roles of artificial intelligence systems, teachers and learners. These three components do not act in isolation but interact with each other constantly during the writing process to promote language growth, critical reflection and learner autonomy. All the research studied have in common the idea that effective writing teaching occurs through the combination of technology capabilities, pedagogical expertise, and active participation of the learner.

The artificial intelligence systems act mainly as intelligent feedback givers that boost the effectiveness of formative evaluation. The instant, constant and individualised feedback that they provide allows learners to discover linguistic faults, to rewrite their drafts and to monitor their writing development without the lags usually associated with traditional evaluation methods. Recent uses of generative AI are not just fixing grammar, spelling, vocabulary, and sentence structure, but are increasingly capable of suggesting improvements in text organization, coherence, and lexical diversity. Thus, AI acts as a catalyst for constant revision, prompting students to adopt iterative writing methods that evolve over time.

AI offers substantial pedagogical support, but, the evidence examined here constantly points out that technological feedback is not enough to achieve full writing proficiency. Current artificial intelligence systems cannot comprehend learners' communicative intentions, disciplinary settings or rhetorical objectives as well as experienced teachers. Automated suggestions can therefore miss essential features of writing such as argument quality, audience awareness, inventiveness, and contextual appropriateness. These restrictions support the conclusion that AI should be considered a teaching assistance tool, not an independent teaching system.

In this collaborative environment, teachers function as pedagogical facilitators, helping learners to interpret and use AI-generated feedback properly. They are responsible for more than the assessment of accuracy of language use in an effort to promote critical thinking, help students to generate ideas, facilitate classroom discussion and promote reflective learning. Moreover, teachers can help learners decide if the automated suggestions are linguistically correct, culturally suitable, and linked with educational goals. This pedagogical mediation allows pupils to transcend beyond mechanical correction and to reach a genuine development in writing.

Another crucial role for teachers is to scaffold learners' interaction with artificial intelligence (AI) tools. Instead of simply using automated feedback, teachers urge students to compare AI suggestions with their own ideas, justify revision decisions, and debate alternative writing styles. Such teaching approaches allow students to engage

more deeply in the material, without over-reliance on smart gadgets. Thus, teachers are indispensable for keeping the educational integrity of AI-supported learning, making technology a tool to improve, not substitute for, significant pedagogical engagement. The third crucial element in this collaborative arrangement is the learners. The research presented demonstrate that students are not passive users of AI-generated feedback but active participants who are accountable for generating knowledge via reflection, evaluation, and correction. They should be able to assess criticism critically, choose among ideas to take on board, modify their texts strategically and judge the success of their adjustments. These learning activities show that successful writing improvement depends on the active cognitive engagement of the learners and not on the mere provision of automated feedback.

The active learner role is in good accordance with the concepts of self-regulated learning. In the writing process, learners set writing goals, track their progress, assess AI-generated ideas, use revision tools, and reflect on the results of their edits. Immediate AI feedback that continuously provides information regarding writing performance improves these self-regulatory processes. Learners, however, remain accountable for making sound judgments about how feedback should be understood and used. Thus, AI operates as a learning resource that enhances self-regulation rather than taking over learners' responsibility for their own learning.

The data also show that feedback literacy is a key mechanism linking the responsibilities of AI, teachers and learners. The AI generates feedback quickly, teachers help learners interpret it, and learners use the information to construct meaningful learning through reflection and correction. Without sufficient feedback literacy, even highly valid feedback from AI might not translate into improved writing, as learners might misinterpret, overlook or misapply the recommendations. In this sense, feedback literacy is the pedagogical bridge between technological support and learning outcomes. The interaction between the artificial intelligence systems and the teachers and learners can thus be viewed as a reciprocal relationship. AI offers technological efficiency by way of instant feedback and frequent refinement. Teachers provide educational knowledge through scaffold, context interpretation and instructional guidance. Learners engage actively in reflection, self-regulation, and knowledge building. Writing development is the result of the continual interaction among these complimentary responsibilities, rather than the solitary contribution of any single component.

Overall, these findings show that AI-assisted writing instruction should be seen as a collaborative, integrated educational ecosystem where technical innovation and human expertise work together to promote meaningful learning. This perspective forms the conceptual foundation for the framework presented in the next part, which highlights the dynamic linkages among AI-generated feedback, instructor scaffolding, learners' self-regulated learning, and writing progress.

A Conceptual Framework of Human–AI Collaboration in EFL Writing

The synthesis of the reviewed literature culminates in the development of a conceptual framework that explains how artificial intelligence, teachers and learners interact to facilitate writing development in EFL classrooms. Instead of portraying AI as an autonomous instructional tool, the suggested framework conceives of writing instruction as a collaborative ecosystem where technology support, pedagogical knowledge, and learner agency interact as interrelated elements. This framework is produced through thematic synthesis of the evaluated papers and includes three

complimentary theoretical perspectives: constructivism, self-regulated learning (SRL) and feedback literacy.

The framework posits three main actors in AI-assisted writing training. The first is AI as a provider of intelligent feedback. AI offers technical efficiency by providing fast, customized, and consistent feedback on grammar, vocabulary, sentence structure, coherence, and organization. Such rapid feedback helps learners detect linguistic errors as they occur, prompting them to revise their work throughout the writing process. Thus, AI increases the accessibility and timeliness of formative evaluation while removing many practical limitations of traditional classroom feedback. The second element is instructors as educational facilitators and agents of scaffolding. AI is good at spotting language errors, but it cannot tell the whole story about communication goals, disciplinary conventions, rhetorical ends, or contextual appropriateness. Teachers therefore remain important in helping learners interpret the feedback generated by AI, to question the automated recommendations, to hold class discussions, and to develop higher-order writing skills including idea development, argumentation, coherence, and audience awareness. The proposed approach sees instructors as mediators who convert technological feedback into meaningful learning experiences through instructional supervision and pedagogical decision-making.

The third element is students as self-regulated learners. Learners are active participants in the writing process as they evaluate feedback, track their writing performance, choose effective revision strategies, execute adjustments, and reflect on learning outcomes. Students are not passive beneficiaries of automated corrections but take responsibility for the construction of knowledge through continual interaction with AI-generated feedback and teacher direction. This active learner role is crucial because real writing growth is contingent upon learners' capacity to critically assess feedback and use it correctly in particular writing contexts.

The interaction of these three elements forms a dynamic learning cycle. AI offers immediate feedback, prompting learners to think about their writing. Teachers then enable learners to read automatic feedback, clear up misconceptions and encourage more in depth revision. Then they revise their writing, evaluate how successful their revisions have been and further develop their texts as they receive further feedback. This recursive process exemplifies writing as an iterative process of learning, involving drafting, feedback, revision, reflection, and ongoing progress rather than as a linear product-oriented activity.

The suggested framework is based on constructivism as a theoretical foundation that considers learning as an active process of constructing knowledge. When using AI-assisted writing instruction, learners develop comprehension through interaction with feedback, revision of their texts, and reflection on their learning experiences. During this process, AI offers cognitive help, and teachers offer meaningful interaction and educational scaffolding. This is learning that takes place with technological resources, pedagogical supervision and learner interaction and not through external instruction just.

Self-regulated learning also accounts for the internal cognitive processes that occur within the framework. AI-generated feedback in real-time helps learners to monitor their performance continuously, discover shortcomings, set revision targets and gauge learning progress. Nevertheless, these methods are effective only if learners can govern their own learning and not only accept the automatic recommendations. Consequently, AI only boosts self-regulation when learners are actively participating in planning,

monitoring, rewriting, and reflecting during the writing process. The feedback literacy serves as the linking process that unites all the components of the framework. AI produces feedback effectively, teachers help to interpret it, and learners convert input into learning by critically evaluating and revising accordingly.

Thus, feedback is considered as a collaborative learning process incorporating technological aid, pedagogical mediation, and learner interaction rather than information passed from one source to another. The framework therefore underlines the fact that the improvement of writing is not only dependent on the availability of feedback but also on the ability of learners to understand, comprehend and use input effectively.

The present study, based on these findings, suggests that effective AI integration in EFL writing should shift from a technology-centered approach to a pedagogy-centered model of human-AI partnership. The approach posits that AI enhances technological efficiency, teachers bring pedagogical knowledge and learners offer self-regulated engagement. Artificial Intelligence and human Pedagogy are complementary to each other in these positions, and their interaction allows the development of writing, leading to a balanced learning environment that capitalizes on the capabilities of each.

The proposed approach expands the existing body of research on AI-assisted language learning by offering an in-depth account of interrelated technological, pedagogical, and learner-related aspects that enable writing development. This methodology differs from prior research which mainly assess the efficiency of specific AI tools by providing a wider pedagogical viewpoint through the integration of intelligent feedback systems with constructivism, self-regulated learning and feedback literacy. Therefore, it provides a theoretical basis for future research and practical implications for educators who want to meaningfully integrate AI into EFL writing programs. The dynamic interaction between AI-generated feedback, instructor scaffolding, and learners' self-regulated learning in the proposed conceptual framework is presented in Figure 1.

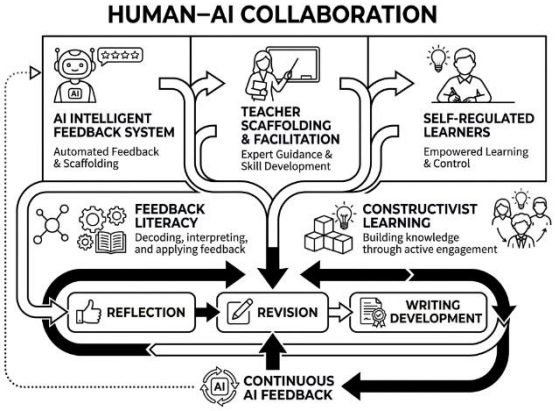

Figure 1. Proposed human–AI collaboration framework for AI-assisted EFL writing instruction

CONCLUSION

This study combined previous literature to build a conceptual framework for human–AI collaboration in EFL writing training. The results highlight the promising

prospect of artificial intelligence in enhancing writing instruction through rapid, tailored, and consistent feedback that can be advantageous for writers during the process of writing. AI-assisted feedback promotes iterative revision, increases writing correctness, and encourages students to take a more active role in monitoring and improving their work. The review also shows that the educational value of AI is not dependent merely on technological competence but also on how it is woven into meaningful pedagogical practices.

The suggested framework suggests that effective AI-assisted writing is produced by the collaborative interaction among three principle components, namely, AI as an intelligent feedback provider, teachers as pedagogical facilitators, and students as self-regulated learners. AI is not a replacement for instructors, but a technological collaborator that boosts the efficiency and accessibility of formative input. Teachers will continue to be responsible for interpreting AI-generated feedback, providing instructional scaffolding, promoting critical thinking, and supporting higher-order writing skills that are beyond the capability of current artificial intelligence (AI) tools. Simultaneously, learners are active agents that critically evaluate feedback, manage their own learning and refine their writing through reflection and revision. The approach is philosophically anchored in constructivism, self-regulated learning and feedback literacy. These complementary approaches indicate that meaningful writing development takes place when learners actively construct knowledge through engagement with AI-generated feedback under pedagogical guidance of teachers.

Therefore, AI should be considered as a cognitive support tool that reinforces learning rather than an autonomous instructional answer. The main contribution of the study is a pedagogical conceptual framework that incorporates technological, pedagogical and learner-centered viewpoints within the framework of AI-assisted EFL writing training. The current framework, unlike earlier studies focusing mainly on the effectiveness of individual AI applications, considers the collaboration of artificial intelligence (AI) systems, teachers and learners in facilitating writing development with intelligent feedback. This integrated perspective gives a more solid theoretical basis for future research on AI-assisted language learning, and provides practical recommendations for educators who wish to deploy AI in meaningful ways in writing classes.

However, despite these achievements, this study has certain drawbacks. The proposed paradigm has not been empirically confirmed as a qualitative library research in authentic classroom settings. Hence, future studies are recommended to explore the implementation and efficacy of the framework using experimental, mixed-method or longitudinal studies with learners of various educational backgrounds. Additional research could study the influence of new artificial intelligence (AI) tools on students' feedback literacy, self-regulated learning, and long-term writing growth.

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