# Beyond Surface Integration: Mapping the Conceptual Gaps and Theoretical Frameworks of AI-Assisted Feedback in English Writing

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**ABSTRACT :** *The use of Large Language Models (LLMs) and Automated Writing Evaluation (AWE) to provide AI-assisted English writing feedback has become more and more common in recent years. But, especially for Southeast Asian EFL students, research has mostly concentrated on surface-level accuracy, leaving gaps in long-term deep learning outcomes like critical thinking and self-regulation. By integrating feedback literacy and self-regulated learning theories with the Student-Teacher-AI Collaboration, AI Risk Ecology, and Cyclical Feedback frameworks, this study employs a systematic review (2023–2025) to close conceptual gaps. The investigation reveals significant gaps in current collaboration techniques, educational equity, and AI literacy. The article proposes a Revised Student-Teacher-AI (S-T-AI) Model and a Hybrid Human-AI Scaffolding Framework to address these problems. In Thailand and other developing countries, these frameworks aim to promote learner autonomy and the ethical, sustainable adoption of AI.*

**KEYWORDS -** *AI-Assisted Feedback, English Writing Instruction, Hybrid Human–AI Scaffolding, Learner Autonomy, AI Literacy*

## I. INTRODUCTION

### 1.1 Background & Rationale

During the past decades, AI-driven feedback has become an important tool that has massively transformed the landscape of English language instruction. AI tools such as Automated Writing Evaluation systems and large language models (e.g., Grammarly and ChatGPT) provide instant feedback, transforming EFL writing instruction while raising questions about their long-term impact on deep learning (Shi, Zhang, & Wei, 2024; Venter, 2025).

However, although these AI tools help improve the effectiveness of grammatical feedback or language accuracy, their 'in-depth results' on long-term learning process remain unclear. Even though many studies found that AI can increase surface-level accuracy in the short term (Alnemrat, Ismail, & Al-Mekhlafi, 2025; Shi, Zhang, & Wei, 2024), there is a lack of empirical evidence that AI can sustainably improve learner autonomy, critical thinking in writing, and higher-order writing processes (Ma & Chen, 2025; Zhan, Y., et al. (2025).

### 1.2 Problems and Conceptual Gap

Studies on AI-assisted feedback increased between 2024 and 2025; however, empirical evidence from EFL contexts, particularly in Southeast Asia, remains scarce. In the Thai context, English instruction in higher education is typically aligned with the CEFR framework for assessing writing skills. However, the obstacles

occurring in English writing classes in Thai higher education have resulted in a number of limitations, such as large-scale classes, heavy faculty workloads, and the digital divide among learners.

According to data from Southeast Asia, learners' comprehension and application of AI-assisted feedback differs greatly depending on their degree of digital access and AI literacy. If AI integration is not planned methodically, this could worsen educational inequality (Daud et al., 2025).

Therefore, rather of being used only for language correction, the integration of AI-assisted feedback in Thai higher education should be planned to be in line with the CEFR framework, emphasizing the use of AI as a facilitator of communicative writing skills, reflection, and self-regulation. Furthermore, in order to guarantee that technology integration is both sustainable and contextually relevant for the Thai educational landscape, institutional regulations pertaining to AI literacy, data privacy protection, and ethical AI usage must be established.

### 1.3 Conceptual Orientation and Structure of the Article
With a focus on learner-teacher-AI connections, this paper attempts to combine significant theoretical frameworks and synthesize important conceptual gaps in the present research on AI-assisted feedback in English writing. The article makes initial recommendations for hybrid and autonomy-oriented frameworks based on this analysis in order to focus future study and instructional design.

The article is divided into five sections in order to accomplish these goals. The contextual background and main issues regarding AI-assisted feedback are introduced in the first part. The trends and types of AI-assisted feedback in English writing classes are reviewed in the second section. Relevant theoretical and conceptual frameworks are examined in the third section. The main conceptual and research gaps are noted in the fourth part. Future framework development strategies to facilitate successful and long-lasting AI integration in English writing education are covered in the concluding part.

## II. TRENDS AND FORMS OF AI-ASSISTED FEEDBACK IN ENGLISH WRITING

### 2.1 Categories of AI Feedback
Three types of artificial intelligence have emerged in recent years for the purpose of giving feedback on English writing.

### 2.1.1 Automated Writing Evaluation (AWE)
An automatic program called AWE (Automated Writing Evaluation) evaluates the readability, coherence, and grammar accuracy of texts while providing learners with instant form-focused feedback (e.g., from Grammarly, Criterion, or ETS E-rater) (Shi, Zhang, & Wei, 2024).

### 2.1.2 Generative AI (GAI)
Using large language models (LLMs), like ChatGPT or Gemini, to provide complicated feedback, explain the reason behind an error, or restructure a sentence for fluency is known as GAI (Generative AI) (Wan, 2023; Daud et al., 2025). With the help of these kinds of technologies, students can gain a deeper understanding of language aspects, going beyond simple error correction to encompass content creation and meaning-making.

### 2.1.3 Corpora-Based Tools

These systems produce context-specific feedback by using data from standard or learner corpora. They promote linguistic awareness and lessen reliance on the system's automated instructions by enabling students to view real-world instances of language usage that are closely related to their own circumstances (Daud et al., 2025).

### 2.2 Pedagogical Outcomes and Challenges

### 2.2.1 Benefits of AI Feedback

Many studies reported that AI can instantly provide feedback and increase the frequency of providing feedback on learners' writing, as well as acting as a "virtual teaching assistant" that helps create a scaffold for beginner to intermediate-level language learners (Alnemrat et al., 2025; Venter, 2025). The results frequently found include the improvement of grammatical accuracy, word choice, and writing fluency.

### 2.2.2 Limitations of AI Feedback

Although there are benefits, there are also a number of limitations, especially concerning the "contextual quality" of the feedback, such as AI not being able to understand author's authentic intention and emotion (Zhan, Y., et al., 2025). Moreover, AI systems tend to provide culturally biased feedback or lack pragmatic and cultural nuance, which may not be suitable for learners from different backgrounds.

### 2.2.3 Challenges of Classroom Use

One important challenge is an over-reliance on AI, which may diminish learners' ability in self-assessment and improvement, or cause an "erosion of learner agency" (Lo, Chan, & Wong. (2025). Moreover, some groups of learners showed a lack of AI literacy towards feedback interpretation, which resulted in being unable to utilize the acquired data effectively and achieving only surface-level learning.

### 2.3 An Overview of Current Tendency

In conclusion, AI obviously shows feedback potential only at a surface level, including grammar, writing mechanism, and word choice; however, it does not completely promote "metacognitive skills", such as critical thinking, argumentation, and rhetorical skills (Shi, Zhang, & Wei, 2024; Venter, 2025).

It can be argued that even though AI can help learners to "write more accurately", it does not help learners to "write more critically". In other words, it is necessary to create conceptual framework that integrates AI with self-regulated learning and the development of feedback literacy to promote authentic deep learning when using AI feedback.

**Table 1.** Summary of AI Feedback Types and Pedagogical Characteristics

| Categories of AI Feedback | Examples of AI Tools | Main Functions | Pedagogical Strengths | Limitations & Challenges | Key References |
|---|---|---|---|---|---|
| 1. Automated Writing Evaluation: AWE | Grammarly, Criterion, ETS E-rater | Automatically analyze grammatical accuracy, text cohesion, and text readability. | - Provide rapid and continuous feedbacks.<br><br>- Suitable for repetitive training to improve linguistic accuracy.<br><br>- Reduce the initial assessment burden on instructors. | - Focus merely on the surface level of language.<br><br>- Unable to understand author's intention or context.<br><br>- May lead to over-reliance on the system by learners. | Shi, Zhang, & Wei (2024) |

| 2. Generative AI: LLM-based Systems) | ChatGPT, Gemini, GrammarlyGO | Employ Large Language Models (LLMs) to generate feedback, explain the rationale for revisions, and adjust the writing style accordingly. | - Provide explanatory and in-depth feedback.<br><br>- Helps foster learners' critical thinking.<br><br>- Able to create writing samples and modify the phrasing. | - May provide inaccurate or biased information stemming from the dataset (AI bias).<br><br>- There are ethical and data privacy limitations.<br><br>- Require teacher guidance to prevent misuse. | Wan (2023); Daud et al. (2025); Zhan et al. (2025) |
|---|---|---|---|---|---|
| 3. Corpora-based Feedback Tools | AntConc, Write & Improve, Compleat Lexical Tutor | Compare learners' writing with a reference corpus or learner corpus to suggest language patterns. | - Helps learners learn from authentic data.<br><br>- Develop an understanding of word usage and sentence structure in authentic contexts.<br><br>- Support data-driven learning (DDL). | - Require language proficiency and corpus analysis skills.<br><br>- May not be suitable for beginner-level learners.<br><br>- Some systems do not yet support pragmatic interpretation. | Daud et al., (2025); Venter (2025) |

This table shows categories of AI feedback for English writing, which can be divided into three main groups, namely: 1) Automated Writing Evaluation (AWE), 2) Generative AI/LLMs, and 3) Corpora-based Tools. This is done by identifying the pedagogical strengths and limitations of each type, as a foundation for developing the Hybrid Feedback Framework in Chapter 5.

### III.  CONCEPTUAL AND THEORETICAL FRAMEWORKS

**3.1 Existing Conceptual Models**

**3.1.1 Student-Teacher-AI Collaboration Model (S-T-AI Model)**
A student-teacher-AI collaboration strategy is suggested by Venter (2025). In order to facilitate ongoing learning development, the model rethinks feedback as a tripartite system in which students, instructors, and AI cooperatively share information.

According to this concept, teachers work as "human mediators," interpreting and expanding AI feedback to meet learning objectives, while AI acts as a "technical assistant," providing basic information on linguistic errors. Students develop into "co-constructors" during this cycle, using knowledge from both sources to evaluate and edit their own work. Learner engagement and self-regulated learning competency are greatly enhanced by these procedures.

### 3.1.2 Higher Education AI Risk Ecology Model (HE-AIRE Model)

This approach was first put forth by Eltharif & Abdalla (2025), who examined a complicated "risk ecology" of AI use in educational contexts that included three primary dimensions:

• Technological risk: Instability in algorithms or data constraints that could compromise the precision of suggestions.

• Ethical risk: Concerns about data bias, impartiality, and privacy violations for learners.

• Cognitive-based risk: An excessive dependence on AI may diminish students' capacity for autonomous thought and internal drive.

Using AI to provide feedback necessitates a balanced design of technological proficiency and learner psychological and ethical sustainability, according to this conceptual paradigm.

### 3.1.3 Cyclical Feedback Framework

Based on Zimmerman's Self-Regulated Learning Model, which has three primary phases, Zhan et al. (2025) suggested viewing feedback as a "cycle process" that continuously recurs.

1. Forethought Phase: Students organize and establish objectives for their writing.

2. Performance-Control Phase: Students use self-evaluation and recommendations from teachers and AI.

3. Reflection-Retrospect Phase: Students consider the criticism in order to modify their approach for the subsequent writing project.

This paradigm aids in understanding that good feedback encourages learners to continuously examine rather than only correcting errors during the "learning cycle."

### 3.1.4 Theoretical Foundations

1) Feedback Literacy Theory

According to this idea, which was put forth by Carless & Boud (2018), one of the key indicators of learning quality is the capacity to understand and apply feedback. For feedback to have a beneficial impact on learners' writing growth, they must have three qualities: appreciation of the feedback, judgment (the capacity to understand and assess it), and action (responding to the recommendations). According to research by Venter (2025), when used in conjunction with instructor direction, AI can support the development of feedback literacy.

2) Self-Regulated Learning (SRL Theory)

According to Eltharif & Abdalla (2025), the use of AI can function as a "self-regulatory scaffold" enabling learners to systematically plan, monitor, and evaluate their own writing. Specifically, when AI feedback is integrated with the learner's reflection, it helps foster a more complete SRL cycle.

3) Formative Assessment Theory

Based on the concept proposed by Black & William (2009), formative assessment focuses on providing continuous feedback, which is interactive and promotes learner growth [2]. Therefore, an integration of AI into this system should be designed so that the feedback is characterized as "dialogue feedback" (a learning conversation) rather than merely a one-sided notification of results.

### 3.1.5 Meta-Analytic Insights

The meta-analytic researches of (Daud et al., 2025) and Alnemrat, Ismail, and Al-Mekhlafi (2025) found that the use of Hybrid Feedback models or "collaborative feedback between AI and the instructor" affects learners' writing quality more than using a single approach, especially regarding language accuracy and perceived usefulness of the feedback.

However, most studies have not proposed "co-construction of learning value" between AI and instructor systematically. In other word, the existing current studies "visualize the outcome", but have not "propose the mechanics" of human-technology collaboration in the feedback process yet.

Therefore, this article emphasizes on generating conceptual mapping to highlight that "AI-assisted feedback" should be considered as collaborative learning ecology that integrates the dimensions of technology, communication, and psychology of learning.

**Figure 1.** Conceptual integration of the AI feedback process, pedagogical principles, and ethical-contextual ecology within the student–teacher–AI collaboration framework.
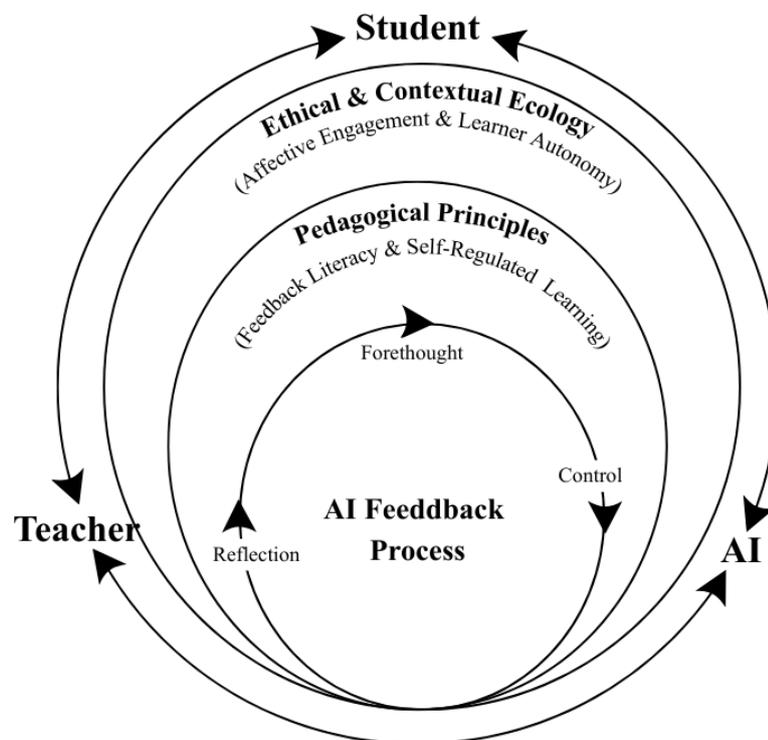


Fig. 1 illustrates the conceptual integration of key theoretical frameworks related to AI-assisted feedback in English writing. The figure synthesizes three interconnected layers: (1) the AI feedback process, (2) pedagogical principles, and (3) the ethical and contextual ecology of AI use. Together, these layers highlight how feedback functions as a cyclical, collaborative learning process within the Student–Teacher–AI interaction framework.

1) Core layer (AI Feedback Process)
This layer shows cyclical process, comprises of three key phases: Forethought (Learners set goals, plan, and anticipate their language needs before receiving AI feedback), control (Learners revise their work based on AI feedback, focusing on aspects such as grammar, sentence structure, and content clarity), and reflection (Learners evaluate their revisions, understand their errors, and prepare for the next writing cycle). It reflects the concept of

Cyclical Feedback Framework [6] and Self-Regulated Learning Model [11], considering that feedback is not merely mistake response, it is also an iterative and continuous learning process.

2) Intermediate Layer (Pedagogical Principles)
According to Carless & Boud (2018), this layer is made up of two fundamental ideas: (1) Feedback Literacy (the capacity of learners to comprehend, assess, and use feedback) and (2) Self-Regulated Learning (SRL) (the capacity of learners to organize, track, and reflect on their own learning). This layer acts as a link between human learning behavior and artificial intelligence (AI).

3) Outer Layer (AI Ethical & Contextual Ecology)
This layer is based on Higher Education AI Risk Ecology Model (HE-AIRE) of Eltharif & Abdalla (2025), emphasizing on equity, privacy, algorithm bias, and behavioral outcomes of learners in AI-driven environments.

4) Bidirectional S-T-AI Interaction
In the outer section of the figure, Student, Teacher, and AI are interconnected with bidirectional arrows in a manner of dialogic feedback loop, which means:
      • Student ↔ AI: Students get feedback and recheck data correctness.
      • AI ↔ Teacher: Teachers use AI to foster the feedback or analyze error pattern.
      • Teacher ↔ Student: Teachers help interpret AI feedback to align with the context and learning objective.
These elements reflect the nature of co-constructive feedback between human and AI.

## IV. IDENTIFIED CONCEPTUAL AND RESEARCH GAPS

Although studies regarding AI-assisted feedback in English language instruction have increased in recent years, based on literature synthesis, most remain "limited by the conceptual framework" and "lacking contextual variety". Consequently, the explanation of the learning mechanism through AI feedback does not yet cover every dimension of long-term writing skill development. This section then focuses on analyzing four primary gaps, including (1) Outcome Gap, (2) Equity and AI Literacy Gap, (3) Contextual Gap, and (4) Framework and Theoretical Gap.

### 4.1 Outcome Gaps: Surface-Level vs. Deep Learning Outcomes
Most research on AI-assisted feedback focuses on surface-level outcomes, such as grammatical accuracy, error reduction, and writing fluency. However, there is still a lack of empirical evidence demonstrating that AI can sustainably support deep learning outcomes, such as critical thinking, meaning-making, argumentative development, and authorial identity (Shi et al., 2024; Zhang, 2025).

To clarify the gaps, this article requires the definition and analysis framework of "surface-level learning" and "deep learning", which is an important basis to identify gaps in the studies on AI-assisted feedback.

1) Surface-Level Learning: Learning outcomes occurring at linguistic or mechanical level, such as:
      • Grammatical accuracy
      • Word choice
      • Basic writing fluency
This type of outcome is an area where AI-assisted feedback demonstrates high effectiveness in multiple research studies, such as correcting minor errors or refining sentence structure (Shi, Zhang & Wei, 2024).

2) Deep Learning: Learning involving semantic understanding and advanced knowledge processing, such as:
      • Critical thinking skill
      • Logical argumentation and components of academic writing
      • Meaning-making and the writer's voice
      • Metacognitive regulation in writing

According to recent research, AI has not yet fully supported deep learning outcomes, especially in domains pertaining to interpretation and meaning construction, which call for higher-order thinking and dialogic engagement with peers or instructors (Zhang, 2025). Shi, Zhang, and Wei (2024) are one example of this.

The deep skill development gap is emphasized as a crucial area for future research since this approach makes a clear distinction between results where AI is very effective and those that still require instructor or human interaction.

### 4.2 Equity and Literacy Gaps

While learners may now easily receive feedback because of the usage of AI for feedback giving, equality and AI bias remain significant challenges that need further investigation (Eltharif & Abdalla, 2025). EFL/ESL learners may obtain unjust assessments due to native-speaker bias, for instance, in certain algorithm systems.

If learners lack an understanding of AI functions, they may employ feedback inappropriately or over-rely on it without reflective reasoning. Meanwhile, some instructors may lack confidence in integrating AI with human assessment, leading to inconsistent practices concerning the quality of hybrid feedback.

### 4.3 Contextual Gaps

Most conceptual frameworks and models in the existing literature regarding AI-assisted feedback are generally developed from Western education contexts, which consist of resources, technologies, and learning support systems that are different from developing country contexts (Daud, Aulia, Muryanti, Harfal, Nabilla, & Ali, 2025). The studies in South East Asian countries, such as Thailand, Indonesia, or Malaysia, are also insufficient, causing a lack of empirical evidence to reaffirm that the developed Western models can be effectively applied in EFL/ESL classroom contexts that are limited by resources.

Moreover, there are educational gaps among learners with different backgrounds, for example, junior high school students, adult language learners for professional purposes, or learners in specialized professional fields (ESP learners), all of whom require different types of feedback. This lack of demographic and contextual diversity means that it is not yet truly possible to design an "AI feedback framework that fits all learner groups".

The studies acquired from non-Western contexts start to reflect significantly specific characteristics among various learners. For example, a study by Daud et al. (2025) in Indonesia showed that learners' ability to interpret AI feedback differed according to their level of digital divide. Furthermore, the study by Aaron & Mahamod (2025) and other small-scaled studies from Malaysia and Thailand reported on the challenges of language, culture, and technology access. These indicate that the development and testing of the AI-assisted feedback framework consequently necessitate evidence from various contexts, such as Asia, Africa, and Latin America, to ensure the model is internationally generalizable and genuinely addresses the needs of learners worldwide.

### 4.4 Framework and Theoretical Gap

According to the existing literature review in the section 3, it is found that although there are variety of developed models, such as S-T-AI Model, HE-AIRE Model, and Cyclical Feedback Framework, these frameworks also have certain limitations, as follows:

1) Technical Emphasis over Cognitive-Affective Processes
Most research studies emphasize system accuracy and feedback delivery speed, rather than understanding the emotional impact, such as learners' confidence, feedback acceptance, and writing motivation.

2) Lack of Explanation Regarding the Construction of Learner Identity
The development of writer identity is considered a key to academic writing study. However, most AI models have not yet described whether the machine feedback affects the development of a sense of ownership or the development of learners' rhetorical voice.

3) Lack of Integration between Pedagogical and technical Design
Even though the models such as S-T-AI consider the collaboration between human and AI, the feedback design at the algorithmic level is unclear as to whether it is connected to pedagogical principles, such as metacognition or reflection-based learning.

To summarize, these gaps indicate that the use of AI feedback is still in the "conceptual transition phase" that needs the integration of technological, pedagogical, and psychological principles to create a theoretical framework that covers all dimensions of English writing skill development in the 21st century.

**Table 2.** Identified Conceptual and Research Gaps in AI-Assisted Feedback Research

| Type of Gap | Conceptual Description | Supporting Evidence | Academic & Pedagogical Implications |
|---|---|---|---|
| **1. Outcome Gap** | Most research reports surface-level outcomes, such as linguistic accuracy, basic fluency, and error reduction. However, there is a gap in in-depth research concerning deep learning outcomes, such as critical thinking skills, meaning-making, logical argumentation, and writer identity development. Therefore, it is necessary to systematically identify and categorize both outcome groups. | Shi, Zhang, & Wei (2024) | Consequently, there is an insufficient understanding of the extent to which AI use affects the development of 'deep writing skills.' This limitation carries significant implications for instructional design, assessment, and the development of future hybrid AI–human models. |
| **2. Equity & AI Literacy Gap** | While AI feedback provides timely information, significant disparities persist among learners regarding AI access, feedback comprehension, the ability to detect bias, and AI literacy, particularly in non-Western and resource-constrained settings. | Eltharif & Abdalla (2025); Lo et al. (2025); Daud et al., (2025) | Inequalities in AI literacy could cause students to become overly dependent on AI or make it more difficult for them to use AI to further deep learning, which would affect educational equity and learning results in general. |
| **3. Contextual Gap** | Many models and research studies are still Western-centric and do not take into account the demands of students learning in Asian or English as a Foreign/Second Language (EFL/ESL) contexts, when linguistic, technological, and resource constraints are present. | Daud et al., (2025); | The use of AI-assisted feedback models in foreign contexts is therefore inappropriate, and more study is required to address student demands in Asia, Africa, and Latin America. |
| **4. Framework & Theoretical Gaps** | Current conceptual frameworks fail to integrate deeper dimensions, such as writer identity, metacognitive processes, affective engagement, and human mediation, into AI systems, leading to a lack of comprehensive understanding of hybrid learning. | Venter (2025); Zhan et al. (2025) | This results in an inability to fully explain the AI–Human Collaboration learning mechanism, which impacts the setting of research agendas and the design of new frameworks, such as the Revised S–T– |

AI Model and Hybrid
Human–AI Scaffolding.

Table 2 shows an overview of conceptual and empirical gaps existing in studies regarding the AI-assisted framework for systematic English writing. This especially focuses on the differences between "surface-level learning outcomes", which are efficiently addressed by AI technology (such as grammar checking and reduction of language errors), and "deep learning outcomes", which involve high-level cognitive process, meaning-making ability, logical reasoning, and reflective thinking, and whose support remains incomplete in recent AI models. Moreover, there are equity gaps, technology access gaps, AI literacy, and contextual gaps among the learners in developing countries. All of these are the issues that render AI incapable of widely and equally providing learning support. Meanwhile, the existing conceptual frameworks have not yet fully described the mechanism of hybrid learning between humans and AI, specifically regarding the dimensions of affection, motivation, learners' autonomy as a writer, and human mediation, which are essential elements directly impacting writing skill development.

Based on the synthesis of these four gaps, it is evident that studies regarding AI-assisted feedback need to move beyond surface-level development and place more emphasis on the deep learning process, including the comprehensive integration of ethics, institutional policies, instructor readiness, and learners' social and cultural contexts.

In order to address the outcome gaps, equity gaps, and complexity of the AI-era learning ecosystem, Section 5 proposes new frameworks, such as the Revised S-T-AI Model and Hybrid Human-AI Scaffolding. The analysis that follows serves as the basis for this section. These frameworks continue to emphasize the cooperative responsibilities of students, teachers, and AI in delivering useful and long-lasting feedback for English writing environments.

## V. DIRECTIONS FOR FUTURE FRAMEWORKS

### 5.1 Hybrid Human-AI Scaffolding Models
It is evident from the previous research that while AI feedback has great promise in terms of speed and accuracy, it is devoid of contextual awareness and author emotion. Future frameworks should therefore result in "Hybrid Human-AI Feedback Systems," which view AI as a "learning co-designer" as opposed to just a "error detector." According to Venter (2025), artificial intelligence (AI) can be used as a "developmental aid" in higher education English writing teaching by assisting teachers with repetitive activities like grammar checking and language formatting, freeing them up to concentrate on critical thinking and creative communication. Furthermore, according to Alnemrat, Ismail, and Al-Mekhlafi (2025), human mediation is necessary for understanding AI feedback in a way that is consistent with learning goals and learners' skill levels.

The hybrid model should apply AI to use in three main dimensions, as follows:
1) Technical Feedback: To detect language accuracy and writing format.
2) Cognitive Scaffolding: To encourage learners to reflect on feedback and set improvement strategies.
3) Affective Scaffolding: To use language that builds motivation and reduces writing anxiety.
This system will lead to a balance between "AI technical accuracy" and "instructors' humanistic understanding", which is regarded as an essential approach to enhancing the quality of future English writing instruction.

### 5.2 Enhancing Learner Autonomy through AI Literacy
Although the learners can easily access AI tools, the efficiency that leads to deep learning still considerably depends on their AI literacy (Eltharif & Abdalla, 2025; Daud et al., 2025). This AI literacy does not refer to merely an ability in clicking or making a command, but it also includes understanding and using AI critically.

### 5.2.1 Key Elements of AI Literacy

1) AI Conceptual Understanding

Learners should be aware of where the AI system gets its information, its biases, its limitations, and its level of uncertainty to avoid over-reliance on AI without prior checking.

2) Critical Feedback Evaluation Skills

Learners should be able to check the accuracy, relevance to the task, and appropriateness of the feedback based on feedback literacy (Carless & Boud, 2018).

3) Prompting and Querying Skills

Learners must be able to design powerful prompts, such as asking for more explanation, requesting a comparison of options, or setting evaluation criteria.

4) AI Bias Awareness

Learners should be able to detect whether the feedback contains linguistic biases, cultural biases, or a Western writing structure [10].

5) Integrated Uptake Skills

Learners should be able to integrate the feedback from AI with that of instructors, and decide which one is appropriate, as well as recording the revision process for future self-reflection.

### 5.2.2 AI Literacy Integration for Self-Regulated Learning

Drawing on these key elements, AI literacy development can be implemented via the following strategies:

- Design activities for learners to compare AI and instructors.
- Practice drafting various types of prompts.
- Use a reflection log for reflection in each writing cycle.
- Develop rubrics for assessing AI literacy ability.
- Provide training for instructors on AI literacy and responsible AI use.
- Integrate AI literacy knowledge into the English writing curriculum, such as by incorporating a unit on "Critical AI use".

### 5.2.3 Implications for the Revised S-T-AI Model Framework

The knowledge of AI literacy is the foundation of the Revised S-T-AI Model since learners serve not only as feedback receivers, but also as "co-constructors of the feedback process". When the learners pose questions, assess the data's quality, and critically apply data obtained from AI critically, the writing system will become a dialogue feedback loop where learners, instructors, and AI meaningfully collaborate (Venter, 2025).

This framework helps explain that the impact of AI relies on an opportunity for learners to continuously analyze, plan, and conduct self-regulated strategies in writing; meanwhile, instructors serve as human mediators and the directors of the deeper meaning of the writing.

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### 5.5 The Proposed Integrative S-T-AI Model

The framework of revised S-T-AI Model illustrates the shared roles among learners, instructors, and AI through the following three phases:

1) Forethought: A phase in which learners set goals and plan for their writing.

2) Control/Performance: A phase in which learners utilize feedback from AI and instructors and make necessary adjustments.

3) Reflection: A phase in which learners reflect on their thoughts, adjust strategies, and improve their writing for the next cycle.

In this model, AI functions as a technical assistant, the instructor serves as a meaning mediator, and the learner is at the core of self-regulation. The model helps to diminish the primary problem of isolating AI and the instructor, and it enhances the explanation of deep learning that takes place across several writing iterations.

**Figure 2.** Revised Student–Teacher–AI (S-T-AI) Model illustrating the cyclical interaction among AI feedback, human mediation, and learner reflection within a hybrid feedback framework.
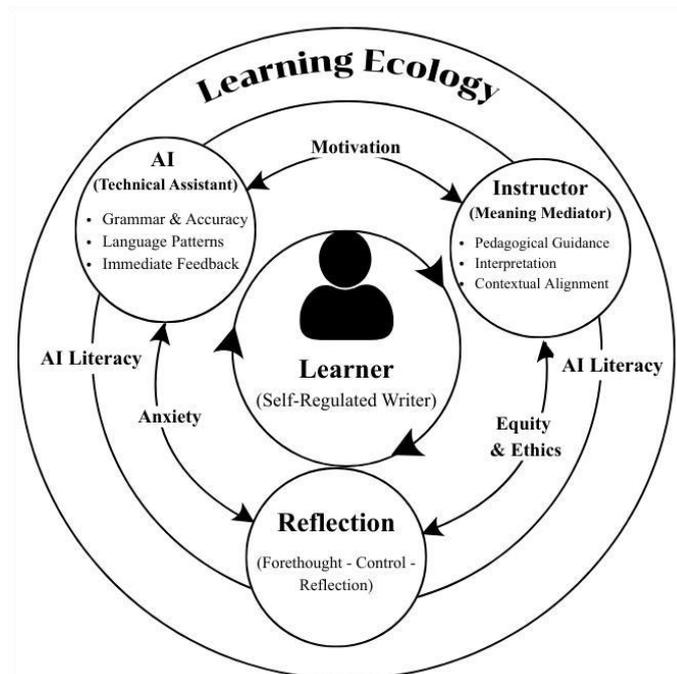
This model demonstrates how AI-assisted feedback in English writing goes well beyond simple error correction. Instead, it operates as a co-constructive learning system where many types of agencies and knowledge come together. AI's language comprehension skills, teachers' pedagogical and interpretive knowledge, students' conscious effort and involvement, and the broader emotional-behavioral ecology surrounding the learning process all interact in a dynamic way. Together, these components provide a networked environment that fosters learners' writing skills to grow more deeply and consistently.

### 5.6 Future Research Directions
Future research should focus on the following to bolster the validity of the suggested framework:
    • Deep Learning Outcomes, which are currently understudied and include critical thinking abilities, argumentation, writers' identities, and self-regulation skills.
    • Non-Western Contexts: they involve students in Southeast Asian nations like Indonesia, Malaysia, and Thailand, whose linguistic identities and access to technology are different from those of students in Western nations (Daud et al., 2025; Aaron & Mahamod, 2025).
    • Consequences for educational and ethical policies, including data protection, privacy, equity, university governance, and responsible AI (RAI).

### 5.7 Methodological and Validation Implications
To be feasible, the revised S-T-AI framework should be implemented by:
    • Conducting pilot studies,
    • Conducting a scenario-based validation,
    • Conducting a multi-draft analysis,
    • Providing learner reflection logs, and
    • Analyzing mixed-method studies.
These will help validate the accuracy of the model's mechanisms and its appropriateness for learners in diverse contexts.

## VI. CONCLUSION AND IMPLICATIONS

### 6.1 Conceptual Synthesis
According to the synthesis of literature review and conceptual framework throughout this article, it is found that the use of AI-assisted feedback has profoundly altered the landscape of English language instruction, especially regarding speed, accuracy, and feedback policy. Nevertheless, the following changes remain technical rather than constituting a shift towards conceptual learning. In other word, although AI can effectively provide feedback at surface-level accuracy, it does not yet support the development of process thinking skills, self-reflection, and complete critical writing (Shi, Zhang, & Wei, 2024).

This reflects the necessity to shift from "surface integration" to "deep integration". In this approach, AI does not serve as a substitute for instructor or assessor; instead, it is a part of the learning ecology that helps learners to understand and manage their own learning more effectively through continuous feedback process.

### 6.2 Theoretical Contributions
This study offers three significant theoretical insights:

1) Integrating Conceptual Frameworks into Collaborative Learning Systems (Integrated Frameworks):
To ground the balanced learning system between technology and educational psychology, an effective AI feedback system must be founded on the theoretical integrations of feedback literacy, self-regulated learning (SRL), and ethical AI use (Eltharif & Abdalla, 2025; Venter, 2025).

2) Encouraging Students and Teachers to Participate Actively in the Feedback Process

According to the Student-Teacher-AI Collaboration Model (S-T-AI), instructors function as instructional guides and interpreters (pedagogical interpreters), while AI acts as a technological mediator. Students should be viewed as co-creators of knowledge.

3) The Creation of a Methodical Framework for Sustainable Education

The creation of cyclical and reflective feedback has been emphasized by new frameworks like the Hybrid Human-AI Scaffolding and the Revised S-T-AI Model, which aid in the development of linguistic proficiency, conscious awareness, and learners' capacity for critical thought.

**6.3 Pedagogical and Policy Implications**

In addition to creating an integrative feedback system between students, teachers, and AI, the application of AI in writing skill development with implications for ethical aspects and institutional policies necessitates careful consideration, particularly with regard to fairness, transparency, data security, and accountability for student learning outcomes. All of these factors are important for the long-term viability of AI-assisted feedback systems and must be carefully controlled to avoid long-term hazards.

1) Institutional Governance

Since the application of AI employed in the learning process consists the complex learning process and may lead to holistic impact, educational institutes should establish clear governance mechanisms, such as:

- AI governance committee,
- Annual AI and curriculum risk assessment meeting, and
- Defining the appropriate scope of AI usage in each course.

The role of educational institutes should encompass the law, security, and practices aligned with the educational mission, all of which serve to prevents the use of AI from becoming a trend devoid of responsibility.

2) Data Protection & Privacy

The use of AI feedback often requires uploading learners' writing, personal data, or academic data of the learners into the AI system. Therefore, rigorous measures are necessary, such as:

- Storing data on certified servers,
- Restricting the use of students' data for model training without consent,
- Obtaining clear and transparent student consent on data usage, and
- Encrypting and restricting data access.

These measures are imperative in higher education institution contexts due to the risks concerning research data and academic intellectual property.

3) Transparency of AI Models

Learners and instructors have the right to be aware of AI functions, such as:

- The source of information,
- The processing mechanisms,
- Its cultural restrictions and data biases, and
- Feedback based on algorithmic reasoning or pattern prediction.

The transparency prevents learners from "being dominated by technology", enabling them to use AI critically and make decisions based on authentic and complete data.

4) Authorial Control

One of the important risks of AI use is that the learners are risk at "loss of writer voice" or overly rely on AI that their writings cannot reflect own idea. To prevent the risk, educational institutes should launch policies that:

- Require learners to affirm that their written work is the result of their own decisions,
- Define the acceptable use policy for AI, and
- Allow the learners to write a reflection explaining how they used AI.

These policies help support self-learning and uphold the purpose of writing skill development.

5) Academic Integrity Policy

Since an existence of AI obscures the boundary between "assistance" and "academic dishonesty", explicit policies should address the following:
- Allowed and disallowed uses of AI,
- The level of AI use considered to be plagiarism,
- Verification of plagiarism resulting from AI output, and
- Educating learners about the consequences of using AI instead of their own skills.

These policies should not be set only for punishment, but should adopt a "developmental approach" that enhances learners' responsibility in technology use.

6) Equity-Oriented Policy Design

Equal access to AI tools should be made available by educational institutions, including:
- Permitting students to use them via the university website,
- Assisting students without devices for internet access, and
- Offering training that is easily accessible.

The learning gap could be greatly widened by unequal access to AI technologies, particularly for students from low-income backgrounds or in non-Western cultures.

7) Implications for Policy-Making at the University and National Levels

For the university level, it is suggested to:
- Create an AI use framework for all courses,
- Standardize AI use policy, and
- Evaluate annual impact of AI use on learning outcomes.

For national level, the Ministry of Education should:
- Launch central guidelines for using AI in instructional management,
- Set criteria for privacy and data protection, and
- Allocate a support fund on AI-assisted feedback research, especially in resource-limited institutions.

**6.4 Future Research Directions**

Based on the conceptual analysis and models proposed in this article, future studies should emphasize a comprehensive and in-depth understanding of AI-assisted feedback in English language instruction, focusing on the following five main aspects.

1) Empirical Validation of Proposed Frameworks

Although the Hybrid Human-AI Scaffolding and Revised S-T-AI Model have the potential to explain the learning approach of human-AI collaboration, empirical studies are also essential. These include:
- Pilot studies,
- Scenario-based validation,
- Classroom-based experimental designs, and
- Multi-draft tracking.

These studies will help validate the accuracy of the model's mechanisms and its contextual appropriateness for Thai learners and learners in other regions.

2) Deep Learning Outcomes Research

As previous works focused on measuring accuracy and error reduction, future research should be expanded to included in-depth outcomes, such as:
- Critical thinking skills,
- Argumentation quality,

• Self-Regulated Learning gains,
• Development of writer identity, and
• Meaning Making.

These outcomes can help determine whether AI systems genuinely support the writing development process "beyond sentence correction".

3) AI Literacy Assessment and Development
Future research should develop assessment criteria and innovations, such as:

• AI literacy rubrics,
• Training modules for instructors,
• Prompt-design competence measurement, and
• Studies on AI literacy outcomes in relation to SRL and writing outcomes.

This is crucial for understanding the "quality of AI use" rather than just the "quantity of AI use".

4) Non-Western and Cross-Cultural Research
The scope of research should be broadened to include countries with diverse linguistic and cultural backgrounds, such as Thailand, Southeast Asian countries, India, Africa, or Latin America, in order to:

• Examine the digital divide,
• Analyze the AI literacy gap,
• Study the stability of language models in non-native English, and
• Test for cultural-linguistic bias.

These approaches will strengthen the "global relevance" of the proposed conceptual framework of the article.

5) Policy-Oriented and Sustainability Research
Future research should investigate:

• Institutional governance frameworks;
• Data and privacy policies;
• Guidelines for maintaining academic integrity;
• The long-term sustainability of learning outcomes when AI is integrated; and
• Governance models specifically tailored for the Thai university context.

This is essential to maximize the benefits of AI while ensuring safety, ethics, and academic standards.

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