ISSN: 2560-5429 Journal of Applied Technical and Educational Sciences http://jates.org/
Vol. 16, No. 1: 420 https://doi.org/10.24368/jates420 1-30

Generative AI as a Scaffold in EFL Writing: A Correlational Study of Writing-Process Mediation among Algerian Master's Students

Bahloul Amel*

1 Batna 2 University, 53, Constantine Road, Fesdis, Batna, 05078, Algeria, a.bahloul@univ-batna2.dz*

Abstract

The rapid integration of generative artificial intelligence (GenAI) into higher education justifies this study, as it increasingly shapes EFL writing, learner autonomy, cognitive engagement, and authorship. Grounded in sociocultural theory, writing process theory, cognitive load theory, and AI literacy, the study builds on previous CALL and AI-assisted writing research while addressing limited evidence from Algerian higher education. It aims to examine how Algerian Master's students use GenAI across EFL writing stages and whether this use reflects scaffolded or substitutional mediation. Its novelty lies in its stage-based correlational approach and the proposed scaffold–substitute continuum. A cross-sectional descriptive-correlational design was adopted, using a questionnaire completed by 549 students and 312 usable AI-use logs. Quantitative data were analyzed through descriptive statistics and Spearman's correlation, while qualitative logs were examined thematically. Findings show that GenAI use was highest during revising and editing, mainly for lexical refinement, grammatical correction, organization, and revision support. Three profiles emerged: scaffolded, hybrid, and substitutional use. The study concludes that GenAI can support EFL writing when used critically, but may reduce cognitive engagement and authorship awareness when used passively. Theoretically, it contributes a scaffold–substitute continuum; practically, it highlights the need for AI literacy, process-oriented assessment, and ethical authorship practices.

Keywords: generative AI; EFL writing; AI-mediated writing; scaffolding; learner autonomy; AI literacy.

1. Introduction

Writing in a second or foreign language is a complex cognitive and metacognitive process involving idea generation, organization, linguistic encoding, monitoring, and revision (Flower & Hayes, 1981; Hyland, 2019). In EFL pedagogy, process-oriented writing emphasizes recursive movement across planning, drafting, revising, and editing, through which learners gradually develop textual competence.

The emergence of generative artificial intelligence (GenAI) has introduced a major shift in this model. Unlike earlier CALL tools, which mainly provided corrective feedback or limited guidance (Warschauer & Healey, 1998), GenAI can generate complete sentences, paragraphs, arguments, and discourse structures, thereby participating more directly in text production (Kohnke et al., 2023). From a sociocultural perspective, GenAI can function as a scaffold by extending learners' cognitive capacities within the writing process (Vygotsky, 1978). However,

because it can produce ready-made output, it may also become a substitute for learners' own cognitive and rhetorical engagement.

Recent research reflects this ambivalence. GenAI may support lexical refinement, grammatical accuracy, fluency, and discourse organization (Barrot, 2023; Kohnke et al., 2023), but it also raises concerns about overreliance, reduced critical thinking, superficial revision, and weakened authorship awareness (Hockly, 2023; Zawacki-Richter et al., 2019). These issues are particularly relevant in EFL contexts, where writing development depends on both linguistic support and active learner engagement.

1.1. Problem Statement

Despite the rapid diffusion of generative artificial intelligence tools in higher education, their role in EFL writing remains insufficiently understood from a process-oriented and correlational perspective. Existing studies have largely examined AI-assisted writing in terms of accuracy, feedback, learner attitudes, or ethical concerns, while less attention has been paid to how students actually appropriate GenAI across different stages of the writing process.

This limitation is particularly evident in underrepresented educational contexts such as Algerian higher education, where empirical evidence on AI-mediated academic writing practices remains scarce. In this context, it remains unclear whether GenAI functions primarily as a scaffold that supports learner engagement, reflection, and revision, or as a substitute that reduces students' active involvement in the construction of written texts.

The central problem addressed in this study is therefore the lack of empirical and correlational evidence on how Algerian Master's students use GenAI during EFL writing and how different patterns of use relate to learner engagement, perceived writing development, critical thinking, and authorship awareness. Without such evidence, pedagogical decisions concerning the integration of GenAI into EFL writing instruction risk being either overly restrictive or uncritically permissive.

1.2. Research Gap

Despite the growing international interest in GenAI-assisted writing, empirical evidence remains limited in underrepresented educational contexts where English is learned as a foreign language and where digital writing practices are shaped by specific institutional, linguistic, and pedagogical conditions. In Algeria, Master's students increasingly use digital tools to support academic writing, yet little is known about how they integrate GenAI across the different stages of the writing process. More specifically, the study is guided by four main gaps in the existing literature:

1 the limited availability of large-scale empirical evidence on GenAI use in EFL writing processes;

2 the lack of stage-based analysis showing how learners use GenAI during brainstorming, outlining, drafting, revising, and editing;

3 the absence of operational models that distinguish scaffolded from substitutional forms of AI-mediated writing;

4 the limited correlational evidence on how GenAI use patterns are associated with learner engagement, perceived writing improvement, critical thinking, and authorship awareness.

Based on these gaps, the present article examines GenAI not merely as a digital writing tool, but as a mediating agent whose pedagogical value depends on how learners appropriate, evaluate, and transform its output during the writing process.

1.3. Aim of the Study

This study aims to investigate patterns of GenAI use in EFL writing among Algerian Master's students. More specifically, it examines how students employ GenAI across the stages of brainstorming, outlining, drafting, revising, and editing, and whether their interaction with AI reflects scaffolded or substitutional forms of mediation.

The study also aims to explore the associations between GenAI use patterns and key dimensions of learner engagement, including perceived writing improvement, critical thinking, and authorship awareness. By doing so, it contributes to current debates on AI-mediated writing by proposing a scaffold-substitute continuum model that can inform the pedagogical integration of GenAI into EFL writing instruction in Algerian higher education.

1.4. Objectives

This study aims to:

1 identify the stages of the writing process in which Algerian Master's students use GenAI most frequently;

2 examine the main purposes of GenAI use in EFL writing;

3 distinguish between scaffolded and substitutional patterns of GenAI use;

4 explore the relationship between GenAI use patterns and students' perceived writing improvement;

5 examine the relationship between GenAI use patterns, authorship awareness, and perceived changes in critical thinking.

1.5. Research Questions

Based on the study's aim, the following research questions were formulated:

RQ1: At which stages of the EFL writing process do Algerian Master's students use GenAI tools most frequently?

RQ2: What are the dominant purposes for which Algerian Master's students use GenAI in EFL writing?

RQ3: How is scaffolded use of GenAI reflected in students' interaction with AI-generated output?

RQ4: How is substitutional use of GenAI reflected in students' direct acceptance of AI-generated output?

RQ5: How are scaffolded and substitutional uses of GenAI associated with perceived writing improvement, authorship awareness, and critical thinking?

1.6. Hypothesis

The study is guided by the following hypothesis:
H1. Generative AI use shapes EFL writing practices among Algerian Master's students in stage-dependent manner, with different patterns of use being associated with scaffolded engagement, substitutional behavior, perceived writing improvement, authorship awareness, and perceived changes in critical thinking.

2. Literature Review

This study is primarily grounded in sociocultural theory, which conceptualizes learning as a socially and culturally mediated process rather than as an isolated individual activity. From this perspective, higher-order cognitive development occurs through interaction with tools, symbols, social agents, and culturally available resources (Vygotsky, 1978). In EFL writing, mediation has traditionally taken the form of teacher feedback, peer collaboration, model texts, dictionaries, grammar references, and digital writing platforms.

Sociocultural theory views learning as a mediated process shaped by tools, interaction, and social resources (Vygotsky, 1978). In EFL writing, mediation has traditionally occurred through teacher feedback, peer collaboration, model texts, dictionaries, grammar references, and digital platforms. GenAI extends this mediational environment because it can generate

complete phrases, paragraphs, outlines, arguments, and discourse structures. Recent studies show that tools such as ChatGPT offer important affordances for language learning, while also raising concerns about accuracy, overreliance, learner autonomy, and ethical use (Barrot, 2023; Hockly, 2023; Kohnke et al., 2023). Thus, GenAI may function as a scaffold when learners critically evaluate and revise its output, but it may become substitutional when they accept generated text passively.

2.1. Writing Process Theory and Stage-Based GenAI Use

Writing process theory conceptualizes writing as a recursive activity involving planning, drafting, reviewing, revising, and editing (Flower & Hayes, 1981). This perspective is particularly relevant to EFL writing because learners must manage content development, grammar, vocabulary, coherence, academic style, and rhetorical appropriateness simultaneously (Hyland, 2019). GenAI may influence each stage differently: it can support brainstorming, help organize outlines, assist drafting, and provide feedback during revision and editing. Recent research on ChatGPT and L2 writing suggests that GenAI can be used before, during, and after writing, but its pedagogical value depends on how learners engage with its output (Barrot, 2023; Crosthwaite & Sun, 2025). At the same time, AI-writing tools may offer an "easy way out" if learners use them to bypass the productive difficulty of writing (Tseng & Warschauer, 2023).

2.2. Feedback, Revision, and Learner Engagement

Feedback plays a central role in writing development, especially in EFL contexts where learners need support with both linguistic accuracy and discourse organization. Research on automated writing evaluation and automated written corrective feedback shows that technology-mediated feedback can support writing improvement, although its effectiveness depends on feedback quality, learner uptake, and classroom integration (Fleckenstein et al., 2023; Hyland, 2019). GenAI changes the nature of feedback by offering interactive reformulations, explanations, alternatives, and extended revision support. However, learners need sufficient competence to evaluate AI-generated suggestions critically (Yan & Zhang, 2024). Recent studies further suggest that ChatGPT can assist in L2 writing accuracy assessment and feedback, but it should not be treated as a replacement for human judgment across all writing dimensions (Mizumoto et al., 2024; Steiss et al., 2024).

2.3. Cognitive Load and AI-Mediated Writing

Cognitive load theory explains how learning depends on the management of mental effort during task performance (Sweller, 1988). EFL writing imposes a high cognitive load because

learners must coordinate ideas, vocabulary, grammar, organization, academic conventions, and audience expectations. GenAI may reduce extraneous cognitive load by supporting linguistic formulation, grammar correction, vocabulary choice, and paragraph organization. This aligns with research suggesting that large language models can provide individualized support, explanations, summaries, and writing assistance (Kasneci et al., 2023). However, excessive reliance on AI may lead to cognitive offloading, where students complete writing tasks without sufficiently processing language, argumentation, or rhetorical choices.

2.4. AI Literacy, Learner Agency, and Ethical Authorship

AI literacy has become central to GenAI-mediated writing because students need to know how to prompt, evaluate, revise, and ethically use AI-generated output. Ng et al. (2021) define AI literacy as including understanding, use, evaluation, creation, and ethical awareness. In EFL writing, AI literacy is closely related to learner agency because students must be able to assess the relevance, accuracy, and originality of AI suggestions. Without these abilities, learners may become dependent on AI-generated text and lose control over meaning-making and authorship. UNESCO (2023) similarly emphasizes the need for human-centered and ethically regulated GenAI use in education. Therefore, responsible AI integration requires transparent documentation, critical evaluation, and clear authorship practices.

2.5. Toward a Scaffold-Substitute Continuum

The reviewed literature suggests that GenAI should not be understood as either entirely beneficial or entirely harmful. Its pedagogical value depends on how learners interact with AI-generated output during the writing process. For this reason, the present study proposes a scaffold-substitute continuum as an analytical model for examining GenAI-mediated EFL writing. The model is informed by existing concepts such as scaffolding, cognitive offloading, and learner agency, but it is not identical to any of them. Scaffolding generally refers to temporary support that helps learners perform beyond their current independent ability. In GenAI-mediated writing, however, support is not always pedagogically scaffolded.

The model is also different from cognitive offloading. Cognitive offloading refers to the transfer of mental effort to an external tool. In writing with GenAI, offloading can be productive when it reduces unnecessary linguistic burden and allows learners to focus on meaning, organization, and revision. However, it can become problematic when it transfers core writing decisions, such as idea development, argument construction, and textual formulation, from the learner to the AI system. The scaffold-substitute continuum therefore specifies whether offloading remains supportive or becomes substitutional. The model further extends the idea of

learner agency. Learner agency usually refers to students' capacity to make decisions and regulate their learning. In this study, agency is operationalized through observable writing behaviors: accepting, modifying, rejecting, justifying, and integrating AI-generated suggestions.

The originality of the scaffold-substitute continuum lies in bringing these dimensions together within a process-oriented model of EFL writing. It connects three elements: the stage of writing in which GenAI is used, the learner's treatment of AI-generated output, and the degree of authorship control maintained in the final text. At the scaffolded end of the continuum, students critically evaluate , adapt, and selectively integrate AI suggestions while maintaining control over meaning and wording. At the substitutional end, students accept AI-generated output with limited modification, weak justification, and blurred authorship awareness. Between these poles, hybrid use reflects partial modification and partial dependence. Thus, the continuum provides an operational framework for distinguishing forms of GenAI use that support writing development from forms that may reduce cognitive engagement and learner authorship. This framework is particularly relevant to EFL writing because learners often need linguistic support but must remain actively involved in idea construction, organization, revision, and ethical authorship.

3. Correlational Rationale for the Study

Because the study adopts a descriptive-correlational design, the framework also justifies examining associations among GenAI use patterns, mediation behaviors, and perceived writing outcomes. The aim is not to establish causality, but to identify whether specific forms of AI use are statistically related to learner engagement.

From a writing process perspective, GenAI use during revising and editing may be associated with scaffolded engagement because these stages involve evaluation, correction, and modification. In contrast, drafting-stage use may be associated with substitutional behavior when students rely on AI to generate complete text with limited transformation.

From sociocultural and cognitive load perspectives, scaffolded use is reflected in modifying, rejecting, and justifying AI suggestions, while substitutional use is reflected in direct acceptance, minimal revision, and reduced learner control. Accordingly, the scaffold-substitute continuum provides the conceptual basis for examining associations between stage-based GenAI use, scaffolded or substitutional engagement, perceived writing improvement, critical thinking, and authorship awareness.

3.1. Connection Between Theory, Research Questions, and Methodology

The theoretical framework directly informs the study's research questions and methodology. Sociocultural theory frames GenAI as a mediational tool, writing process theory justifies the stage-based analysis, cognitive load theory explains both support and possible cognitive offloading, and AI literacy provides the lens for examining learner agency and authorship awareness. These perspectives are reflected in the instruments. The questionnaire measures GenAI use frequency, writing-stage engagement, perceived improvement, critical thinking, and authorship awareness, while the AI-use logs document how students accept, modify, reject, or justify AI-generated suggestions.

The correlational dimension is also theoretically grounded. Questionnaire variables and log-based indicators of scaffolded, hybrid, and substitutional use allow Spearman's correlation analysis to examine associations among GenAI use patterns, learner engagement, perceived outcomes, and authorship awareness. Thus, the framework provides the conceptual basis for interpreting GenAI-mediated writing as a matter of tool use, learner agency, cognitive engagement, and ethical authorship.

4. Methodology

4.1. Research Design

This study adopted a cross-sectional descriptive-correlational research design supported by qualitative AI-use log analysis. The cross-sectional dimension means that data were collected at one point in time from Algerian Master2 EFL students. The descriptive dimension was used to identify how frequently students used GenAI across the stages of brainstorming, outlining, drafting, revising, and editing. The correlational dimension was used to examine statistical associations between GenAI use patterns, scaffolded engagement, substitutional behavior, perceived writing improvement, critical thinking, authorship awareness, and AI literacy. Fig. 1.

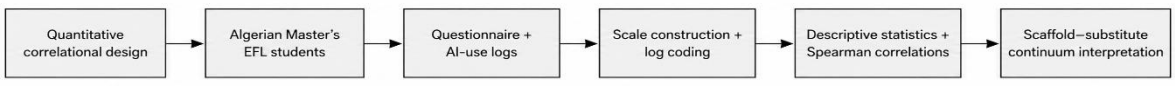

Figure 1. Research Design of the Study

The study did not involve experimental manipulation and did not aim to establish causal relationships. Instead, it examined existing GenAI-mediated writing practices and the relationships among reported and log-based indicators. Qualitative data were collected through an online questionnaire, while qualitative process-oriented data were collected through AI-use logs based on a short academic paragraph-writing task. This combination allowed the study to describe broad patterns of GenAI use while also examining how students accepted , modified, rejected, or justified AI-generated output during writing.

4.2. Participants and Sampling Procedure

The participants were 549 Algerian Master 2 students enrolled in EFL programs at six Algerian universities: Batna 2 University, Biskra University, Algiers 2 University, Bejaia University, Tlemcen University, and Saida University. These six universities were selected because they provided institutional and geographical diversity within Algerian EFL higher education and were accessible to the researcher for data collection. Master 2 students were selected because they are advanced EFL learners who are regularly required to complete academic writing tasks. They were therefore considered suitable for examining how GenAI tools are used in academic writing. The study used a non-probability purposive sampling technique. Participants were selected according to two criteria: they had to be enrolled in a Master 2 EFL program, and they had to have prior experience using GenAI tools for academic writing or language-learning purposes Table 1.

Table 1. The distribution of participants

University	Number of participants
Batna 2 University	145
Biskra University	92
Algiers 2 University	88
Bejaia University	80
Tlemcen University	75
Saida University	69
Total	549

Participants were recruited through online class groups and teacher-mediated sharing of the questionnaire link. Participation was voluntary, and no academic reward or penalty was associated with participation.

4.3. Data Collection Procedure

Data were collected online over a period of four weeks. The questionnaire was distributed through a digital survey form. Before answering, participants were informed about the purpose of the study, the voluntary nature of participation, confidentiality, and their right to withdraw at any stage. After completing the questionnaire, participants were invited to complete an AI-

use log based on a short academic paragraph-writing task. The task required students to write a short academic paragraph and document how they used GenAI during the writing process. The paragraph task was chosen because it was simple, manageable, and suitable for identifying GenAI use across different writing stages, including brainstorming, outlining, drafting, revising, and editing. A total of 549 questionnaire responses were retained for quantitative analysis. For the qualitative component, 312 usable AI-use logs were retained. Incomplete logs or logs that did not clearly show how students interacted with AI-generated output were excluded.

4.4. Instruments

Two instruments were used: an online questionnaire and AI-use logs. The questionnaire provided quantitative data on students' frequency of GenAI use, writing-stage engagement, perceived writing development, critical thinking, authorship awareness, dependence on AI-generated output, and AI literacy. The AI-use logs provided process-oriented evidence of how students interacted with GenAI-generated suggestions during a short academic paragraph-writing task.

4.4.1. Online Questionnaire

The online questionnaire was designed to collect data on students' GenAI use in EFL writing. It included 30 items divided into simple sections (Table 2).

Table 2. Online Questionnaire Design

Section	Number of items	Cronbach's alpha
Background information and GenAI experience	4	-
Frequency and stages of GenAI use	6	0.86
Purposes of GenAI use	5	0.82
Scaffolded engagement	4	0.88
Substitutional behavior / dependence	3	0.84
Perceived writing improvement	3	0.85
Critical thinking and authorship awareness	3	0.78
AI literacy	2	0.80
Total/ Overall questionnaire	30	0.91

Note: The questionnaire used two types of five-point Likert scales. For frequency items (1 = Never 2 = Rarely 3 = Sometimes 4 = Often 5 = Always) and for agreement items (1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly agree). For descriptive reporting, frequency responses were grouped into three categories: high use =often/always, moderate use=sometimes, and low/no use =rarely/never. Agreement responses were also grouped into three categories: positive=agree/strongly agree, neutral /uncertain=neutral, and negative=disagree/strongly disagree.

The main questionnaire variables were constructed as composite indicators. Overall GenAI use frequency was calculated from items measuring students' general and stage-based use of GenAI in writing. Stage-based use was examined separately for brainstorming, outlining, drafting, revising, and editing. Scaffolded engagement was constructed from items measuring evaluation, selective use, modification, and justification of AI-generated output. Substitutional behavior was constructed from items measuring direct acceptance of AI-generated text, dependence on AI suggestions, and limited independent revision. Perceived writing improvement was based on students' reported improvement in lexical choice, grammatical accuracy, coherence, and structure. Authorship awareness and perceived critical thinking were examined through items addressing students' sense of ownership, clarity of contribution, and perceived change in independent thinking when using GenAI. Ai literacy was measured through items related to students' ability to prompt, evaluate, revise, and ethically document AI-assisted writing. Negatively worded items were reverse-coded where necessary so that higher values consistently represented stronger presence of the measured construct. Composite scores were calculated by averaging the relevant items for each scale.

4.4.2. AI-Use Logs and Coding Procedure

The AI-use logs were used to collect process-oriented data on how students interacted with GenAI during the paragraph-writing task. Each log asked students to report: the writing stage in which GenAI was used; the prompt submitted to the AI tool; the type of output generated by GenAI; whether the output was accepted, modified, or rejected; a short justification for their decision.

The unit of analysis was the individual AI-use log. Each log was coded according to five operational indicators: writing stage, type of AI output, treatment of AI output, degree of student modification, and justification of the writing decision. The treatment of AI output was coded as acceptable, modified, or rejected. Modification included lexical changes, grammatical correction, restructuring, content adaptation, partial rewriting, or selective integration of AI-generated suggestions. Justification referred to any explicit explanation showing why student accepted , changed, or rejected the AI suggestion. The logs were used to classify students' GenAI use into three mediation profiles:

1 **Scaffolded use**: the student evaluated, revised, or selectively used AI-generated output;

2 **Hybrid use**: the student modified some AI suggestions but accepted others directly;

3 **Substitutional use**: the student accepted AI-generated output with little or no modification.

This classification was used to support the scaffold-substitute continuum proposed in the study. To strengthen the coding reliability, two trained coders independently coded a randomly selected subset of 25% of the usable logs. Before coding , both coders reviewed the coding scheme and discussed examples of scaffolded, hybrid, and substitutional use. Intercoder reliability was assessed using Cohen's kappa. The reliability values were κ=0.89 for writing-stage identification, κ=0.86 for treatment of AI output, and κ=0.83 for mediation-profile classification. These values indicate strong agreement. Disagreements were resolved through discussion, and the agreed coding criteria were then applied to the remaining logs. Incomplete logs, unclear responses, and logs that did not provide enough evidence od interaction with AI-generated output were excluded. This resulted in 312 usable AI-use logs for qualitative analysis.

4.4.3. Validity and Reliability of Questionnaire scales

To improve content validity, the questionnaire was reviewed by two university teachers in EFL writing and applied linguistics. They checked the clarity, relevance, and suitability of the items for Algerian Master 2 EFL students. Based on their comments, some items were simplified and repeated ideas were removed. A small pilot study was conducted with 20 Master 2 EFL students who were not included in the final sample. The pilot study helped check whether the questionnaire items and AI-use log instructions were clear. Internal consistency was assessed using Cronbach's alpha. The reliability coefficients ranged from $\alpha = 0.78$ to $\alpha = 0.91$, indicating acceptable to excellent reliability (Table 2). The values indicate that the questionnaire scales had acceptable to excellent internal consistency. The lowest reliability value was recorded for the critical thinking and authorship awareness scale, which may be explained by the conceptual complexity of this construct. The highest reliability was recorded for the overall questionnaire, indicating strong consistency across the full instrument.

4.5. Data Analysis

Quantitative data from the questionnaire were analyzed using descriptive statistics and Spearman's rank-order correlation. Frequencies and percentages were used to describe the distribution of GenAI use across writing stages, purposes of use, perceived writing effects, and mediation profiles. Percentages were calculated using the relevant sample size for each dataset: N= 549 for the questionnaire results and n=312 for usable AI-use logs.

Spearman's rho was used because the main variables were measured through ordinal Likert-type items and because the study aimed to identify associations rather than causal effect. Correlations were reported using Spearman's rho, p-values, sample size, and interpretation of association strength. The level of statistical significance was set at $p < 0.05$.

Correlations were interpreted as weak, moderate, or strong according to their absolute continuum as the coding framework. The analysis focused on whether students accepted, modified, rejected, or justified AI-generated output. The coded logs were then grouped into scaffolded, hybrid, and substitutional profiles.

4.6. Ethical Considerations

Because the study involved human participants, ethical procedures for educational research were followed throughout the data collection and analysis process. Participants were informed about the purpose of the study, the voluntary nature of participation, the type of data collected and their right to withdraw at any stage. Informed consent was obtained before participants completed the questionnaire and AI-use log. No personally identifiable information was collected. Questionnaire responses and AI-use logs were treated confidentially and were used only for research purposes. Students were not evaluated on the quality of their writing or on their decision to use or not use GenAI. Participation had no effect on their academic grades, assessment, or institutional standing.

Given that GenAI use in academic writing can be ethically sensitive, participants were assured that their responses would remain anonymous and would not be shared with teachers or administrators in a way that could identify them. The study therefore respected the principles of informed consent, voluntary participation, anonymity, confidentiality, and protection from academic harm.

5. Results

The findings obtained from questionnaire and AI-use logs are organized according to the main variables of the study, starting with students ‘stage-based use of GenAI in EFL writing and moving toward mediation profiles, perceived effects and correlational relationships.

5.1. Descriptive Overview of GenAI Integration in EFL Writing

The results show that GenAI use was not evenly distributed across all stages. Instead, students reported higher levels of use during revising and editing than during drafting. As shown in Fig2, GenAI was most frequently used during revising and editing, which suggests that students mainly relied on AI tools for improving, correcting, and refining texts after an initial draft had been produced.

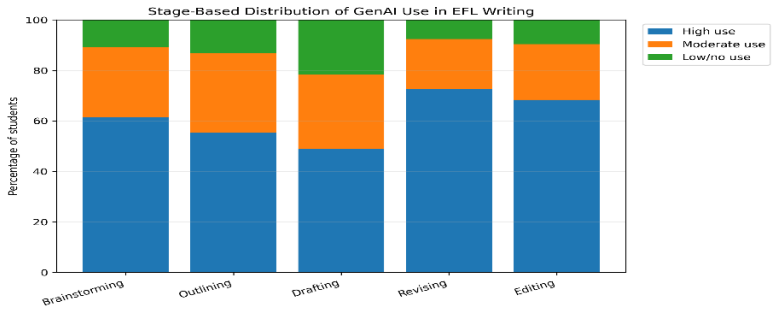

Figure 2. Stage-Based Distribution of GenAI Use in EFL Writing

5.2. Stage-Based Distribution of GenAI Use

The questionnaire data show that GenAI use in EFL writing was selective and stage-dependent. Students did not report using GenAI equally across all stages of the writing process. The highest levels of use appeared during revising and editing , suggesting that GenAI was mainly used for linguistic refinement, lexical choice, grammatical correction, and textual improvement after an initial draft had been produced.

The results also show that GenAI was used during earlier stages of writing, particularly brainstorming and outlining. However, drafting recorded the lowest level of high use, indicating that students were more cautious when using GenAI for full text formulation. This pattern suggest that GenAI was more frequently used as a support tool for improving or organizing writing than as a complete replacement for student-generated text. The detailed distribution of GenAI across the five stages is presented in Table 3.

Table 3. Distribution of GenAI Use Across Writing Stages (N = 549)

Writing Stage	High Use (%)	Moderate Use (%)	Low/No Use (%)	Dominant Function
Brainstorming	61.4	27.8	10.8	Idea support
Outlining	55.2	31.6	13.2	Structural organization
Drafting	48.9	29.4	21.7	Text formulation
Revising	72.6	19.8	7.6	Content and language refinement
Editing	68.3	22.1	9.6	Linguistic correction

Note: High use refers to responses of 'often' or 'always' on the five-point frequency scale. Moderate use refers to 'sometimes'. Low/no use refers to 'rarely' or 'never'. The dominant function was derived from the most frequently reported purpose of GenAI use at each writing stage.

The highest level of GenAI use was reported during the revising stage, with 72.6% of students indicating high use. Editing came second, with 68.3% reporting high use. These results suggest that students most frequently relied on GenAI after producing an initial version of their writing. Brainstorming also recorded a relatively high level of use, with 61.4% of students reporting

high use. This shows that GenAI was not limited to surface-level correction, since many students also used it to generate ideas or explore possible directions for writing. Outlining also showed considerable use, with 55.2% reporting high use, suggesting that GenAI supported students in organizing ideas and structuring their paragraphs Table 3.

Drafting recorded the lowest level of high use, at 48.9%. Although this percentage remains important, it indicates more cautious or mixed engagement when students were required to produce actual written content. Overall, the results show a clear hierarchy of use: GenAI was most frequently used for revising and editing, moderately used for brainstorming and outlining, and least used for full drafting.

5.3. Typology of AI-Mediated Writing Behavior

The AI-use logs made it possible to identify three main patterns of learner engagement with GenAI-generated output: scaffolded use, hybrid use, and substitutional use. This analysis was based on 312 usable AI-use logs collected during the short academic paragraph-writing task.

Table 4. AI-Mediated Writing Profiles Based on Log Analysis (n = 312)

Mediation Type	Main Characteristics	N	Percentage (%)
Scaffolded use	Students evaluated, modified, and adapted AI suggestions before integrating them into their texts.	178	57.0
Hybrid use	Students accepted some AI suggestions directly but modified others selectively.	87	28.0
Substitutional use	Students adopted AI-generated output with little or no modification.	47	15.0
Total		312	100

Note: Profiles were derived from students' documented treatment of AI-generated output during the paragraph-writing task. Scaffolded use indicates evaluation, modification, selective adoption, or justification of AI suggestions. Hybrid use indicates partial modification combined with partial direct acceptance. Substitutional use indicates direct or near-direct acceptance of AI-generated output with little or no modification.

The results show that scaffolded use was the dominant form of AI-mediated writing behavior. A total of 178 logs, representing 57.0% of the usable logs, showed evidence of scaffolded engagement. In these cases, students used GenAI as a support tool while maintaining control over their writing decisions. They revised, reformulated, selected, or justified the integration of AI-generated suggestions. Hybrid use appeared in 87 logs, representing 28.0% of the usable logs. These students combined active and passive behaviors. They modified some AI-generated suggestions but accepted others with limited revision. This indicates that AI-mediated writing behavior was not always fully scaffolded or fully substitutional, but often occurred between the two. Substitutional use appeared in 47 logs, representing 15.0% of the usable logs. These logs showed direct or near-direct acceptance of AI-generated output with little evidence of

modification or critical evaluation. This pattern suggests a potential risk of overreliance on GenAI and reduced learner involvement in the writing process Table 4.

5.4. Students' Perceived Pedagogical Impact of GenAI

Students' perceptions of GenAI were examined in relation to five dimensions: lexical enrichment, grammatical accuracy, coherence and structure, critical thinking, and authorship clarity. For presentation purposes, Likert-scale responses were grouped into three categories: positive, negative, and neutral/uncertain.

Table 5. Perceived Effects of GenAI on Writing Competence (N = 549)

Dimension	Positive (%)	Negative (%)	Neutral/Uncertain (%)
Lexical enrichment	84.3	6.1	9.6
Grammatical accuracy	79.8	8.4	11.8
Coherence and structure	73.5	10.2	16.3
Critical thinking	32.6	61.9	5.5
Authorship clarity	28.4	66.7	4.9

Note: Positive responses combine ‘agree’ and ‘strongly agree’. Negative responses combine ‘disagree’ and ‘strongly disagree’. Neutral/uncertain responses correspond to ‘neutral’. The dimensions were derived from questionnaire items measuring perceived linguistic, organizational, cognitive, and authorship-related effects of GenAI use.

The results show that students perceived GenAI most positively in relation to linguistic and organizational aspects of writing. Lexical enrichment received the highest positive rating, with 84.3% of students reporting a positive effect. Grammatical accuracy was also strongly rated, with 79.8% of students reporting positive effects. Coherence and structure also received a high positive rating, at 73.5%. However, the results were different for critical thinking and authorship clarity. A majority of students reported negative perceptions regarding the effect of GenAI on critical thinking, with 61.9% indicating a negative effect. Similarly, 66.7% reported a negative perception regarding authorship clarity. These findings suggest that students recognized the usefulness of GenAI for improving language and organization, but also perceived risks related to reduced independent thinking and blurred ownership of written work. This contrast shows that students did not view GenAI as entirely beneficial or entirely harmful. Instead, they perceived it as useful for surface-level and organizational improvement, while also recognizing its possible negative effects on deeper cognitive and ethical dimensions of academic writing Table 5.

5.5. The Scaffold-Substitute Continuum

The integration of questionnaire data and AI-use logs supports the existence of a scaffold-substitute continuum of GenAI-mediated writing behavior. Students' practices did not fall into

a simple binary distinction between appropriate and inappropriate use. Rather, their engagement ranged from active and reflective use to passive dependence on AI-generated output. At the scaffolded end of the continuum, students showed evidence of: rewriting AI-generated suggestions; selecting only relevant parts of the output; comparing AI suggestions with their own ideas; justifying acceptance or rejection of AI-generated text; maintaining control over meaning and final wording. At the substitutional end of the continuum, students showed evidence of: direct copying of AI-generated output; limited or absent revision; reliance on AI for idea generation and formulation; weak justification of writing choices; reduced evidence of independent textual decision-making.

Table 6. Operational Indicators of the Scaffold-Substitute Continuum

Dimension	Scaffolded Use	Hybrid Use	Substitutional Use
Learner control	High	Moderate	Low
Treatment of AI output	Evaluated and revised	Partly revised	Mostly accepted
Writing decision-making	Learner-led	Shared between learner and AI	AI-led
Revision behavior	Frequent and purposeful	Occasional	Minimal
Authorship awareness	Clear	Partially clear	Weak or blurred
Cognitive engagement	Active	Variable	Limited

Note: The continuum was constructed from questionnaire indicators and AI-use log coding. Scaffolded use reflects learner control, evaluation, revision, and authorship awareness. Substitutional use reflects direct acceptance, minimal revision, and reduced independent decision-making. Hybrid use represents intermediate forms of engagement.

The continuum shows that GenAI use may vary not only from one learner to another, but also according to the writing stage. For example, some students used GenAI scaffoldedly during revision but more substitutionally during drafting. This suggests that AI-mediated writing behavior depends on both the learner's level of engagement and the nature of the writing task Table 6.

5.6. Correlational Analysis of GenAI Use and Mediation Patterns

Spearman's rank-order correlation analysis was conducted to examine associations among GenAI use patterns, mediation behaviors, and perceived writing outcomes. Spearman's rho was selected because the main questionnaire variables were measured through Likert-type items. The analysis focused on relationships between stage-based GenAI use, scaffolded engagement, substitutional behavior, perceived writing improvement, critical thinking, authorship awareness, and AI literacy. The correlation matrix is visually summarized in Fig 3, while the values are reported in Table 7.

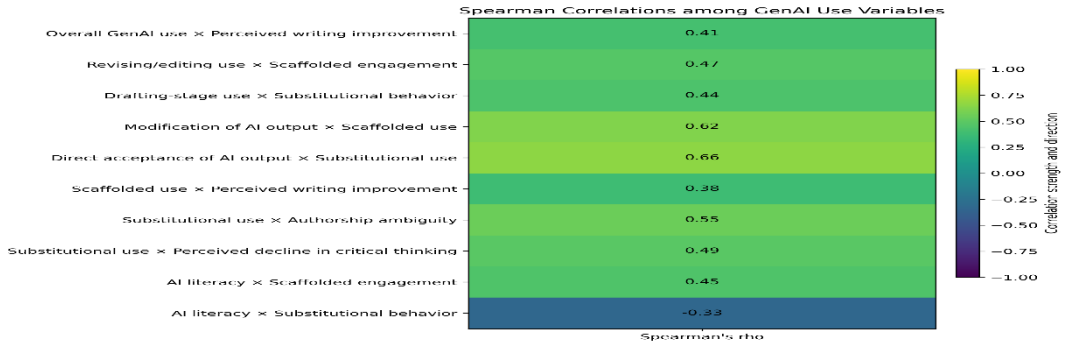

Figure 3. Heatmap of Spearman Correlations among GenAI Use Variables

The heatmap shows that the strongest positive relationships were found between direct acceptance of AI-generated output and substitutional use, and between modification of AI-generated output and scaffolded use. The only negative association was found between AI literacy and substitutional behavior. The detailed Spearman correlation coefficients are presented in Table 7.

Table 7. Spearman Correlations among GenAI Use Patterns, Mediation Behavior, and Perceived Outcomes

Variables	Spearman's rho	p-value	Interpretation
Overall GenAI use frequency × Perceived writing improvement	0.41	< 0.001	Moderate positive association
Revising/editing use × Scaffolded engagement	0.47	< 0.001	Moderate positive association
Drafting-stage use × Substitutional behavior	0.44	< 0.001	Moderate positive association
Modification of AI-generated output × Scaffolded use	0.62	< 0.001	Strong positive association
Direct acceptance of AI-generated output × Substitutional use	0.66	< 0.001	Strong positive association
Scaffolded use × Perceived writing improvement	0.38	< 0.001	Moderate positive association
Substitutional use × Authorship ambiguity	0.55	< 0.001	Strong positive association
Substitutional use × Perceived decline in critical thinking	0.49	< 0.001	Moderate positive association
AI literacy × Scaffolded engagement	0.45	< 0.001	Moderate positive association
AI literacy × Substitutional behavior	-0.33	< 0.001	Moderate negative association

Note: Spearman's rho was used because the variables were based on Likert-scale responses. Correlations indicate associations, not causal relationships. Statistical significance was set at $p < 0.05$. All reported p-values below 0.001 indicate highly significant associations.

The correlational results indicate that GenAI use was associated with different forms of learner engagement. Overall GenAI use frequency showed a moderate positive association with perceived writing improvement ($\rho = 0.41$, $p < 0.001$). This suggests that students who used GenAI more frequently tended to report stronger perceived benefits for their writing.

A moderate positive association was found between revising/editing use and scaffolded engagement ($\rho = 0.47$, $p < 0.001$). This indicates that students who used GenAI during post-drafting stages were more likely to evaluate, modify, and selectively integrate AI-generated suggestions. In contrast, drafting-stage use was moderately associated with substitutional behavior ($\rho = 0.44$, $p < 0.001$), suggesting that students who used GenAI during text production were more likely to rely on AI-generated output with limited transformation.

The strongest associations were observed between modification of AI-generated output and scaffolded use ($\rho = 0.62$, $p < 0.001$), and between direct acceptance of AI-generated output and substitutional use ($\rho = 0.66$, $p < 0.001$). These results support the operational distinction between scaffolded and substitutional AI-mediated writing behavior. Modification appears to be closely linked with scaffolded engagement, while direct acceptance appears to be closely linked with substitutional use.

Scaffolded use was moderately associated with perceived writing improvement ($\rho = 0.38$, $p < 0.001$), indicating that reflective engagement with AI output was related to students' perceived development in writing. By contrast, substitutional use was strongly associated with authorship ambiguity ($\rho = 0.55$, $p < 0.001$) and moderately associated with perceived decline in critical thinking ($\rho = 0.49$, $p < 0.001$). These findings suggest that passive reliance on GenAI may be linked to weaker authorship awareness and reduced cognitive engagement.

AI literacy was positively associated with scaffolded engagement ($\rho = 0.45$, $p < 0.001$) and negatively associated with substitutional behavior ($\rho = -0.33$, $p < 0.001$). This suggests that students with stronger AI literacy were more likely to use GenAI critically and less likely to depend on it passively.

These correlations should be interpreted as associations rather than causal relationships. The results do not show that GenAI use causes scaffolded engagement, substitutional behavior, improved writing, authorship ambiguity, or reduced critical thinking. Rather, they show that particular patterns of GenAI use are statistically related to particular forms of learner engagement and perception.

6. Findings

The results show that GenAI use among Algerian Master 2 students is stage-dependent. The highest levels of use occurred during revising and editing, while drafting recorded the lowest level of high use. This suggests that students mainly used GenAI to improve, refine, and organize their writing rather than to produce complete texts from the beginning.

The AI-use logs revealed three mediation profiles: scaffolded use, hybrid use, and substitutional use. Scaffolded use was the most common profile, representing 57.0% of the usable logs. Hybrid use represented 28.0%, while substitutional use represented 15.0%. These findings support the idea that GenAI-mediated writing exists on a continuum rather than as a simple distinction between acceptable and unacceptable use.

The correlational results further support this continuum. Revising and editing uses were associated with scaffolded engagement, while drafting-stage use was associated with substitutional behavior. Scaffolded use was linked to perceived writing improvement, whereas substitutional use was associated with authorship ambiguity and perceived decline in critical thinking.

Taken together, the findings suggest that the pedagogical value of GenAI in EFL writing depends not only on whether students use AI, but also on how, when, and why they use it during the writing process. Reflective and selective use appears to support writing development, while passive acceptance of AI-generated output may reduce learner control, authorship awareness, and cognitive engagement.

7. Discussion

This section interprets the findings in relation to the research questions and the scaffold-substitute continuum. The questionnaire findings were based on 549 participants, while the mediation profiles were based on 312 usable AI-use logs collected during a short academic paragraph-writing task.

7.1. Clarifying the Originality of the Model

The scaffold substitute continuum contributes to current research by offering a process-based model for interpreting GenAI-mediated writing. Its originality does not lie in claiming that GenAI can scaffold learning, since this idea is already connected to sociocultural theory. Rather, its contribution lies in showing that GenAI use may shift along a continuum from support to substitution depending on how learners treat AI-generated output (Vygotsky, 1978; Hockly, 2023; Kohnke et al.,2023).

This distinction is important because GenAI can perform both supportive and replacement functions. When students use AI suggestions as material for comparison, revision, and reflection, GenAI acts as a scaffold. When students rely on AI to formulate ideas, produce text, and make writing decisions with little modification, the same tool becomes substitutional. The model therefore adds precision to existing discussions of scaffolding, cognitive offloading, and learner agency by linking them to observable writing behaviors (Sweller,1988; Ng et al., 2021).

In this study, the continuum was operationalized through AI-use logs and questionnaire indicators. Modification, selective adoption, rejection, and justification of AI suggestions were treated as indicators of scaffolded engagement. Direct acceptance, minimal revision, and weak justification were treated as indicators of substitutional behavior. Hybrid use represented intermediate cases. In this way, the model provides a practical analytical tool for researchers and teachers who need to distinguish between pedagogically productive and potentially problematic forms of GenAI use in EFL writing.

7.2. Stage-Based GenAI Use in EFL Writing

The findings show that Algerian Master 2 students used GenAI selectively across the writing process. The highest levels of use appeared during revising and editing, while drafting recorded the lowest level of high use. This suggests that students mainly used GenAI after producing an initial version of their text, especially for lexical refinement, grammatical correction, coherence, and textual improvement (Flower & Hayes, 1981; Hyland, 2019).

This pattern indicates that GenAI was more often used as a support tool than as a complete replacement for student writing. Revising and editing require evaluation, comparison, and decision-making; therefore, GenAI use at these stages may encourage scaffolded engagement. By contrast, the association between drafting-stage use and substitutional behavior suggests that using GenAI for text production may increase the risk of passive reliance on AI-generated output (Barrot, 2023; Crosthwaite & Sun, 2025; Tseng & Warschauer, 2023). From a sociocultural perspective, GenAI can be viewed as a mediational tool. However, its pedagogical value depends on how learners use it. When students evaluate and revise AI suggestions, GenAI functions as a scaffold (Vygotsky, 1978). When they accept generated text with little modification, it becomes more substitutional .

7.3. Scaffolded, Hybrid, and Substitutional Use

The AI-use logs revealed three mediation profiles: scaffolded, hybrid, and substitutional use. Since these profiles were based on 312 usable logs, they should be interpreted as complementary process evidence rather than as a full classification of all questionnaire

respondents. Scaffolded use was the dominant profile. In these cases, students evaluated, modified, reformulated, or selectively integrated AI-generated suggestions while maintaining control over their writing. Hybrid use showed that AI-mediated writing is not always purely scaffolded or purely substitutional, since some students modified certain suggestions but accepted others more directly. Substitutional use was less frequent, but pedagogically important. It involved accepting AI-generated output with little or no modification. This pattern suggests possible risks for learner control, authorship awareness, and independent cognitive engagement. Therefore, the main issue is not whether students use GenAI, but whether they use it critically and reflectively.

7.4. Linguistic Benefits and Cognitive Risks

Students perceived GenAI positively for lexical enrichment, grammatical accuracy, and coherence. This confirms its usefulness for supporting linguistic and organizational aspects of EFL writing. For learners who face difficulties with vocabulary, grammar, and academic style, GenAI may reduce linguistic burden and support text improvement (Barrot,2023; Fleckenstein et al., 2023; Hyland, 2019; Kohnke et al., 2023). However, students also reported negative perceptions regarding critical thinking and authorship clarity. This shows that they recognized the risks of passive or excessive reliance on GenAI. Linguistic improvement does not necessarily mean deeper writing development. When GenAI performs too much of the writing process, it may encourage cognitive offloading rather than active learning (Sweller,1988; Kasneci et al., 2023). These findings should be interpreted cautiously because critical thinking and authorship clarity were measured through students' perceptions, not through direct performance assessment.

7.5. AI Literacy and Learner Agency

The correlational findings highlight the importance of AI literacy. AI literacy was positively associated with scaffolded engagement and negatively associated with substitutional behavior. This suggests that students with stronger AI literacy were more likely to evaluate, revise, and control AI-generated output (Ng et al., 2021). The strongest correlations also support the distinction between scaffolded and substitutional use. Modification of AI output was strongly associated with scaffolded engagement, while direct acceptance was strongly associated with substitutional behavior. These results show that students' treatment of AI output is a key indicator of whether GenAI supports or replaces learner engagement (Yan & Zhang, 2024; Mizumoto et al., 2024; Steiss et al., 2024). However, these findings remain correlational. They do not prove that AI literacy causes scaffolded engagement or that drafting-stage use causes substitutional behavior. They only show statistically significant associations.

7.6. Pedagogical and Theoretical Implications

The findings have several implications for EFL writing pedagogy and for the theoretical interpretation of GenAI-mediated writing. These implications can be summarized through four main relationships: (1) The relationship between writing stage and learner engagement suggest that GenAI should be integrated into writing instruction through a process-oriented approach. Since revising and editing were associated with scaffolded engagement, teachers can guide students to use GenAI for feedback, reformulation, comparison, and revision rather than for direct text production. (2) The relationship between AI-output modification and scaffolded use indicates that the pedagogical value of GenAI depends on how students treat AI-generated suggestions. Students should be trained to compare AI output with their own ideas, revise generated text, reject unsuitable suggestions , and justify the changes. (3) The relationship between direct acceptance and substitutional behavior shows that uncritical use of GenAI may reduce learner control and authorship awareness. For this reason, assessment should not focus only on the final written product. Teachers should also consider prompts, drafts, revision histories, AI-use logs, and students' explanations of how AI was used. (4) The relationship between AI literacy and scaffolded engagement highlights the importance of explicit AI literacy training . Students need to learn how to formulate prompts , evaluate AI-generated output, identify inaccurate or generic suggestions, revise AI-assisted text, and document GenAI use ethically.

Theoretically, these relationships support the scaffold-substitute continuum. The model shows that GenAI is neither automatically beneficial nor automatically harmful. Its pedagogical value depends on the writing stage, the degree of learner control, and the extent to which AI-generated output is evaluated, modified, and integrated into the learner's own writing.

7.7. Critical Methodological Reflection and Limitations

Although the findings provide useful evidence on GenAI-mediated EFL writing, they should be interpreted with caution. First , the questionnaire data were based on students' self-reported perceptions and practices. Self-reported data are useful for understanding learners' experiences, attitudes, and perceived benefits, but they may also be affected by memory limitation, social desirability, and differences between what students report doing and what they actually do during writing. Therefore, the reported benefits of GenAI for lexical enrichment, grammar, coherence, critical thinking, and authorship awareness should be understood as perceived effects rather than directly measured learning outcomes.

Second, the study used purposive sampling. This sampling strategy was appropriate for the research aim because the study focused on students who were already familiar with GenAI-assisted writing. However, it limits the generalizability of the findings. The results cannot be assumed to represent all Algerian EFL students at other academic levels, or learners who have little or no experience using GenAI.

Third, the questionnaire and AI-use of datasets differed in size . While 549 questionnaire responses were analyzed quantitatively, only 312 usable AI-use logs were retained for the qualitative component. Therefore, the log-based profiles should be treated as complementary process evidence rather than as classification of all respondents.

Fourth, the AI-use logs were based on a short paragraph-writing task, which allowed manageable observation of GenAI use across writing stages. However, this task does not fully represent longer academic genres such as essays, dissertations, or research articles, where argumentation, source integration, and multiple revisions are required.

Fifth, the study did not include direct pre/post writing-performance assessment. Thus, it connot determine whether GenAI use objectively improved writing quality over time. The link between scaffolded use and perceived writing improvement reflects self-reported perceptions and correlational patterns, not measured writing development.

Finally, because the study used a cross-sectional descriptive-correlational design, the findings cannot establish causal relationships. The associations between revising /editing use and scaffolded engagement, or between drafting-stage use and substitutional behavior, indicate statistical relationships only. The scaffold-substitute continuum should therefore be further tested through longitudinal , experimental, and classroom-based research.

8. Conclusion

The study examined GenAI as a mediational tool in EFL writing among Algerian Master's students. The findings showed that GenAI use was stage-dependent, with the highest use occurring during revising and editing. The AI-use logs identified three profiles of engagement with GenAI-generated output: scaffolded, hybrid, and substitutional use.

The study proposes the scaffold-substitute continuum as a model for interpreting GenAI-mediated writing. Scaffolded use involves evaluating, modifying, and selectively integrating AI suggestions while maintaining learner control and authorship. Substitutional use involves accepting AI-generated output with limited revision and weaker independent decision-making. The correlational results supported this distinction, as revising/editing use was associated with scaffolded engagement, whereas drafting-stage use was associated with substitutional behavior.

These findings should be interpreted cautiously. The study relied partly on self-reported data, used purposive sampling, and analyzed AI-use logs based on a short paragraph-writing task. It also did not include direct pre/post writing-performance assessment. Therefore, the findings indicate perceived and correlational associations rather than causal or objectively measured writing improvement.

Despite these limitations, the study contributes to EFL writing research by offering an operational model for distinguishing productive and problematic forms of GenAI use. It highlights the need for AI literacy, process-oriented assessment, transparent documentation of AI use , and ethical authorship practices. Future research should use longitudinal performance across different genres.

Acknowledgements

The author thanks the Algerian Master's students who participated in this study and the teachers who helped distribute the research instruments. Generative AI tools were used only for proofreading and minor linguistic refinement. All AI-assisted suggestions were reviewed, revised, and validated by the author, who assumes full responsibility for the final content, interpretation, and conclusions of the manuscript.

Ethics statement

This article does not involve any original experimental studies with human or animal subjects. Therefore, no ethical approval was required for this work.

Funding statement

The author received no financial support for the research, authorship, and/or publication of this article.

Declaration of competing interest

The author declares that she has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Barrot, J. S. (2023). Using ChatGPT for second language writing: Pitfalls and potentials. Assessing Writing, 57, Article 100745. https://doi.org/10.1016/j.asw.2023.100745

Crosthwaite, P., & Sun, S. (2025). Generative AI and L2 written feedback studies: A scoping review. RELC Journal, 57(1), 207–219. https://doi.org/10.1177/00336882251386530

Fleckenstein, J., Liebenow, L. W., & Meyer, J. (2023). Automated feedback and writing: A multi-level meta-analysis of effects on students' performance. Frontiers in Artificial Intelligence, 6, Article 1162454. https://doi.org/10.3389/frai.2023.1162454

Flower, L., & Hayes, J. R. (1981). A cognitive process theory of writing. College Composition and Communication, 32(4), 365–387. https://doi.org/10.2307/356600

Hockly, N. (2023). Artificial intelligence in English language teaching: The good, the bad and the ugly. RELC Journal, 54(2), 445–451. https://doi.org/10.1177/00336882231168504

Hyland, K. (2019). Second language writing (2nd ed.). Cambridge University Press. Kasneci, E., Sessler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., Gasser, U., Groh, G., Günnemann, S., Hüllermeier, E., Krusche, S., Kutyniok, G., Michaeli, T., Nerdel, C., Pfeffer, J., Poquet, O., Sailer, M., Schmidt, A., Seidel, T., ... Kasneci, G. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. Learning and Individual Differences, 103, Article 102274. https://doi.org/10.1016/j.lindif.2023.102274

Kohnke, L., Moorhouse, B. L., & Zou, D. (2023). ChatGPT for language teaching and learning. RELC Journal, 54(2), 537–550. https://doi.org/10.1177/00336882231162868

Mizumoto, A., Shintani, N., Sasaki, M., & Teng, M. F. (2024). Testing the viability of ChatGPT as a companion in L2 writing accuracy assessment. Research Methods in Applied Linguistics, 3(2), Article 100116. https://doi.org/10.1016/j.rmal.2024.100116

Ng, D. T. K., Leung, J. K. L., Chu, S. K. W., & Qiao, M. S. (2021). Conceptualizing AI literacy: An exploratory review. Computers and Education: Artificial Intelligence, 2, Article 100041. https://doi.org/10.1016/j.caeai.2021.100041

Steiss, J., Tate, T., Graham, S., Cruz, J., Hebert, M., Wang, J., Moon, Y., Tseng, W., Warschauer, M., & Olson, C. B. (2024). Comparing the quality of human and ChatGPT feedback of students' writing. Learning and Instruction, 91, Article 101894. https://doi.org/10.1016/j.learninstruc.2024.101894

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. Cognitive Science, 12(2), 257–285. https://doi.org/10.1207/s15516709cog1202_4

Tseng, W., & Warschauer, M. (2023). AI-writing tools in education: If you can't beat them, join them. Journal of China Computer-Assisted Language Learning, 3(2), 258–262. https://doi.org/10.1515/jccall-2023-0008

UNESCO. (2023). Guidance for generative AI in education and research. UNESCO.

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes.

Harvard University Press.

Warschauer, M., & Healey, D. (1998). Computers and language learning: An overview. Language Teaching, 31(2), 57–71. https://doi.org/10.1017/S0261444800012970

Yan, D., & Zhang, S. (2024). L2 writer engagement with automated written corrective feedback provided by ChatGPT: A mixed-method multiple case study. Humanities and Social Sciences Communications, 11, Article 1086. https://doi.org/10.1057/s41599-024-03543-y

Zawacki-Richter, O., Marín, V.I., Bond, M. *et al.* Systematic review of research on artificial intelligence applications in higher education – where are the educators?. *Int J Educ Technol High Educ* **16**, 39 (2019). https://doi.org/10.1186/s41239-019-0171-0

Appendices

Appendix A : The Online Questionnaire

This questionnaire aims to explore how Algerian Master 2 EFL students use generative artificial intelligence tools, such as ChatGPT, Gemini, Copilot, or similar systems, during academic writing. The questionnaire focuses on writing stages, purposes of use, scaffolded and substitutional engagement, perceived writing improvement, critical thinking, authorship awareness, and AI literacy.

Instructions: Please answer honestly based on your own experience. Your answers are anonymous and will be used only for research purposes.

Section A: Background Information and GenAI Experience

1. University: ☐ Batna 2 University ☐ Biskra University ☐ Algiers 2 University ☐ Bejaia University ☐ Tlemcen University ☐ Saida University

2. Level of study: ☐ Master 2

3. Have you used GenAI tools for academic writing or language-learning purposes?

☐ Yes ☐ No

4. Which GenAI tool do you use most often?

☐ ChatGPT ☐ Gemini ☐ Microsoft Copilot ☐ Claude

☐ Other: _____

Section B: Frequency and Stages of GenAI Use (For the following items, use this scale: 1 = Never 2 = Rarely 3 = Sometimes 4 = Often 5 = Always)

No.	Item	1	2	3	4	5
5	I use GenAI tools when completing academic writing tasks in English.	☐	☐	☐	☐	☐
6	I use GenAI during the brainstorming stage to generate or explore ideas.	☐	☐	☐	☐	☐
7	I use GenAI during the outlining stage to organize my ideas.	☐	☐	☐	☐	☐
8	I use GenAI during the drafting stage to help formulate sentences or paragraphs.	☐	☐	☐	☐	☐
9	I use GenAI during the revising stage to improve content, clarity, and organization.	☐	☐	☐	☐	☐
10	I use GenAI during the editing stage to correct grammar, vocabulary, and style.	☐	☐	☐	☐	☐

Section C: Purposes of GenAI Use in EFL Writing (Use the same frequency scale: 1 = Never 2 = Rarely 3 = Sometimes 4 = Often 5 = Always)

No.	Item	1	2	3	4	5
11	I use GenAI to generate ideas before writing.	☐	☐	☐	☐	☐
12	I use GenAI to improve my vocabulary and word choice.	☐	☐	☐	☐	☐

No.	Item	1	2	3	4	5
13	I use GenAI to correct grammatical errors.	☐	☐	☐	☐	☐
14	I use GenAI to improve coherence and paragraph organization.	☐	☐	☐	☐	☐
15	I use GenAI to revise or reformulate parts of my text.	☐	☐	☐	☐	☐

Section D: Scaffolded Engagement with GenAI (For the following items, use this scale: 1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly agree)

No.	Item	1	2	3	4	5
16	I evaluate AI-generated suggestions before using them in my writing.	☐	☐	☐	☐	☐
17	I modify AI-generated output to match my own ideas and writing purpose.	☐	☐	☐	☐	☐
18	I reject AI-generated suggestions when they are inaccurate or unsuitable.	☐	☐	☐	☐	☐
19	I use GenAI as a support tool while keeping control over my final text.	☐	☐	☐	☐	☐

Section E: Substitutional Use and Dependence (Use the same agreement scale: 1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly agree)

No.	Item	1	2	3	4	5
20	I sometimes accept AI-generated text without making important changes.	☐	☐	☐	☐	☐
21	I rely on GenAI to write parts of my text that I find difficult to produce myself.	☐	☐	☐	☐	☐
22	I feel dependent on GenAI when completing academic writing tasks.	☐	☐	☐	☐	☐

Section F: Perceived Writing Improvement (Use the same agreement scale: 1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly agree)

No.	Item	1	2	3	4	5
23	GenAI helps me enrich my vocabulary in English writing.	☐	☐	☐	☐	☐
24	GenAI helps me improve grammatical accuracy in my writing.	☐	☐	☐	☐	☐
25	GenAI helps me improve coherence and structure in my paragraphs.	☐	☐	☐	☐	☐

Section G: Critical Thinking and Authorship Awareness (Use the same agreement scale: 1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly agree)

No.	Item	1	2	3	4	5
26	GenAI use encourages me to think critically about my writing choices.	☐	☐	☐	☐	☐
27	When I use GenAI, I can clearly distinguish my own contribution from AI-generated suggestions.	☐	☐	☐	☐	☐
28	I am careful not to present AI-generated text as entirely my own work.	☐	☐	☐	☐	☐

Section H: AI Literacy (Use the same agreement scale: 1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly agree)

No.	Item	1	2	3	4	5
29	I know how to write prompts that help GenAI provide useful writing support.	☐	☐	☐	☐	☐
30	I know that AI-generated output should be checked, revised, and used ethically.	☐	☐	☐	☐	☐

Appendix B : AI-Use Log for the Short Academic Paragraph-Writing Task

Instructions for Students : You are asked to write a short academic paragraph in English. During the writing process, you may use a GenAI tool such as ChatGPT, Gemini, Copilot, Claude, or another similar tool. Please document how you used GenAI by completing the table below. Your answers are anonymous and will be used only for research purposes.

Writing Task : Write a short academic paragraph of approximately **120–150 words** on the following topic: **The role of technology in improving university students' learning.**

You may use GenAI during any stage of the writing process: brainstorming, outlining, drafting, revising, or editing.

AI-Use Log Template

Writing stage	Prompt submitted to GenAI	Type of AI output received	Your response to the output	Short justification
☐ Brainstorming ☐ Outlining ☐ Drafting ☐ Revising ☐ Editing		☐ Ideas ☐ Outline ☐ Sentences/paragraph ☐ Correction ☐ Reformulation ☐ Other: ____	☐ Accepted directly ☐ Modified ☐ Rejected ☐ Partly accepted	

Students may complete more than one row if they use GenAI at different stages.

Coding Guide for the Researcher : The log entries were classified as follows:

Category	Operational indicator
Scaffolded use	The student evaluated, modified, reformulated, or selectively integrated AI-generated output.
Hybrid use	The student modified some AI suggestions but accepted others more directly.
Substitutional use	The student accepted AI-generated output with little or no modification.