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Writing Development and SRL Awareness in GenAI-Supported EFL Writing: Associations with Revision Behaviors

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Abstract: This study examined changes in writing performance and self-regulated learning (SRL) awareness among 82 university students using a GenAI-supported English as a Foreign Language (EFL) writing system with SRL scaffolding. Results showed significant improvements in writing performance and increased intrinsic value, a motivational subcomponent of SRL. Submission frequency predicted post-test writing performance beyond baseline levels. Lag sequential analysis further revealed that high improvement was associated with significant behavioral transitions from evaluative monitoring to revision. These findings suggest that writing development in GenAI environments depends not only on the amount of system use but also on how revision processes are structurally enacted within an SRL-informed design.

Keywords: generative AI, self-regulated learning, EFL writing, feedback

1. Introduction and Related Work

Generative artificial intelligence (GenAI) is increasingly used to provide automated feedback in writing instruction, offering immediate linguistic and content-level guidance that supports revision efficiency and learner autonomy. At the same time, concerns have been raised regarding potential overreliance on AI-generated feedback and reduced metacognitive engagement (Guo & Wang, 2024). Exploring how learners engage with AI-generated feedback is therefore a critical issue in contemporary English as a Foreign Language (EFL) writing research. Self-regulated learning (SRL) provides a theoretical lens for examining these concerns. SRL involves the capacity of learners to plan, monitor, and evaluate their own learning processes (Zimmerman, 2000) and is widely associated with improved academic performance (Schunk & Zimmerman, 2007). Within writing research, SRL is recognized as a key factor supporting development and strategic engagement (Harris & Graham, 2009). These perspectives suggest that effective writing development requires both external feedback and learners' active regulation of their learning. However, research on SRL in EFL writing remains limited, and the integration of large language models is even more recent. While prior studies report performance improvements following Large Language Model (LLM) integration (e.g., Liu et al., 2024), it remains unclear how GenAI-supported instruction influences SRL awareness and what behavioral mechanisms drive these effects.

From a learning analytics perspective, GenAI-supported writing systems generate log data that capture observable engagement behaviors, such as draft submission and feedback viewing. Yet few studies have examined how such behavioral engagement is associated with writing development and changes in SRL awareness in GenAI-supported EFL contexts. To address these gaps, the present study examines changes in writing performance and SRL awareness in a GenAI-supported EFL writing course and investigates the associations between system engagement behaviors and these learning outcomes.

2. Purpose of the Study

This study aims to examine changes in writing performance and SRL awareness in a GenAI-supported EFL writing course and their associations with system engagement behaviors. It addresses two research questions: (RQ1) how did writing performance and SRL awareness change during the GenAI-supported course? and (RQ2) how were system engagement behaviors associated with writing development and changes in SRL awareness?

3. Methodology

This study was conducted over one semester (September 2025 to January 2026) in a compulsory undergraduate English course at a Japanese university. Participants were 82 first-year students at a beginner-level, corresponding to A1 to A2 on the Common European Framework of Reference for Languages (CEFR). To support writing development, we implemented a web-based GenAI-supported feedback system powered by GPT-4 (Geng, Tanaka, & Yamada, 2025), which was informed by Zimmerman's (2000) three-phase cyclical model of SRL. The system provided Language Corrections with metalinguistic explanations, Comprehensive Writing Feedback for content and organization, and SRL Scaffolding Feedback for monitoring and reflection, in addition to a writing-history comparison feature. Writing performance was evaluated via pre- and post-test tasks across four dimensions adapted from IELTS Writing Task 2 band descriptors (0–9 scale), while SRL awareness was measured using the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich & De Groot, 1990). Analysis procedures included: (RQ1) paired-samples t-tests and lexical analysis of reflections to examine pre-post changes; and (RQ2) Pearson correlation, hierarchical regression, and Lag Sequential Analysis (LSA) to investigate associations between engagement behaviors and outcomes.

4. Results and Discussion

4.1 Changes in Writing Performance and SRL Awareness (RQ1)

Regarding RQ1, paired-samples t-tests indicated significant improvements in overall writing performance from pre-test (M = 2.89, SD = 0.88) to post-test (M = 4.02, SD = 0.85), $t(81) = 11.29$, $p < .001$, $d = 1.25$. Significant gains were observed across all analytic dimensions: Task Response, $t(81) = 10.40$, $p < .001$, $d = 1.15$; Coherence and Cohesion, $t(81) = 11.84$, $p < .001$, $d = 1.31$; Lexical Resource, $t(81) = 9.73$, $p < .001$, $d = 1.07$; and Grammatical Range and Accuracy, $t(81) = 8.50$, $p < .001$, $d = 0.94$. Regarding SRL awareness, results showed no significant changes in overall scores from pre-test (M = 191.0, SD = 28.6) to post-test (M = 193.0, SD = 31.1), $t(81) = 1.16$, $p = .251$, $d = 0.13$. Only intrinsic value showed a significant increase from pre-test (M = 44.0, SD = 8.8) to post-test (M = 45.5, SD = 9.0), $t(81) = 2.22$, $p = .029$, $d = 0.25$, whereas other subscales did not change significantly.

A frequency-based lexical analysis of post-course reflections (N = 82) was conducted to explore the increase in intrinsic value. Students reflected on what writing in English meant to them, where frequent content words included English (n = 73) and writing (n = 50). Self-referential expressions (n = 36) and can-do statements (n = 20) were also prominent. Reflections emphasized the ability to communicate personal thoughts and increased confidence in independent writing, suggesting enhanced self-efficacy. Responses also indicated metacognitive awareness, such as reflecting on thinking or organizing feelings. Frequent references to international orientation (n = 20), future orientation (n = 16), and usefulness (n = 16) suggested that writing was perceived as beneficial for the future, providing qualitative support for the observed increase in intrinsic value.

4.2 Associations Between Engagement and Learning Outcomes (RQ2)

Regarding RQ2, Pearson correlation analyses showed that pre-test writing performance was positively correlated with total SRL awareness (r = .25, p = .021), self-efficacy (r = .31, p = .005), and self-regulation (r = .22, p = .043). Submission frequency also correlated with writing growth (r = .27, p < .05). Hierarchical regression analyses, controlling for baseline levels, revealed that baseline writing significantly predicted post-test performance (β = .46, p < .001). Among engagement indicators, only submission frequency uniquely predicted post-test writing performance (β = .23, p = .024), accounting for an additional 5.3% of variance (ΔR^2 = .053), with the full model explaining 24.4% of the variance (R^2 = .244). Multicollinearity was not a concern, as all *VIF* values were below 2.0. A parallel model for SRL awareness indicated that baseline scores strongly predicted post-test levels (β = .90, p < .001; R^2 = .698). No significant correlations or predictive effects were observed between engagement indicators and changes in SRL awareness.

To examine revision-process sequences, LSA was conducted using extreme groups defined by the 25th and 75th percentile cutoffs of writing gain scores: the high-improvement group (n = 36) and the low-improvement group (n = 27). The remaining 19 participants were excluded to increase contrast. Lag 1 transitions with adjusted residuals above 1.96 (p < .05) were considered significant. As shown in Figure 1, while both groups shared feedback-to-comparison and comparison-to-submission transitions, the high-improvement group uniquely demonstrated a significant transition from comparison completion to submission (close_comparison to submit_writing). This pattern suggests a tighter coupling between evaluative actions and subsequent submission behavior. Conversely, the low-improvement group showed a significant transition from feedback reception to writing-history navigation (received_feedback to click_tab_writing_history), suggesting a less direct translation of feedback into immediate revision. These findings reveal qualitative differences in revision-process structure. No substantial differences in transition patterns were observed when grouping by SRL change (increase: n = 44; decrease: n = 38).

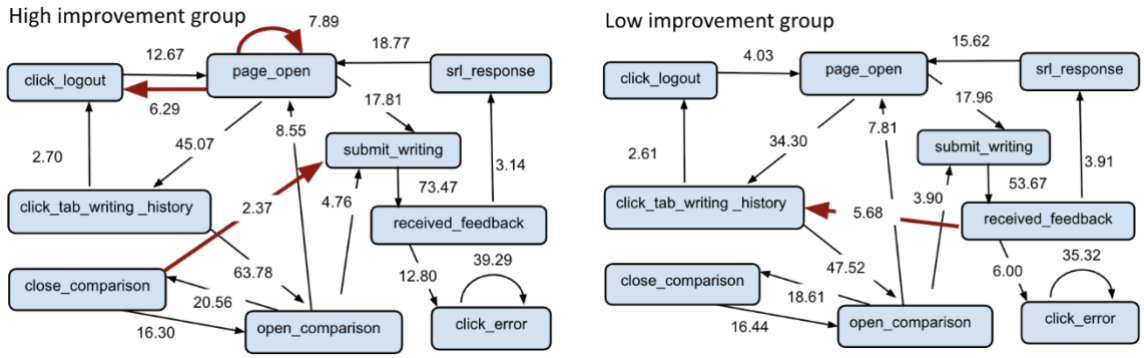

Figure 1. Comparison of LSA results by writing improvement group

4.3 Discussion

Regarding RQ1, the results showed substantial improvement in writing performance while overall SRL awareness remained stable. Within the SRL measures, only intrinsic value, a motivational subcomponent of SRL, increased significantly. The reflection texts provide a qualitative account of this increase: students' post-course reflections frequently referred to expressing their own ideas, communicating beyond the classroom, and writing independently. These descriptions indicate that students increasingly perceived English writing as personally meaningful while broader self-reported SRL awareness showed limited change during the course. Regarding RQ2, the correlation and regression analyses showed that submission frequency was positively associated with writing performance and remained a significant predictor after controlling for baseline proficiency. This indicates that more frequent engagement in drafting and feedback cycles within the GenAI-supported writing system was associated with stronger writing outcomes. The LSA findings further suggest that writing

improvement in the present GenAI-supported writing course was associated not only with submission frequency but also with revision-process structure, as reflected in how learners organized revision-related actions during system use. This interpretation is consistent with prior EFL writing research showing that outcomes vary depending on how GenAI-supported feedback is used in the revision process (e.g., Mekheimer, 2025; Tanaka, Geng, & Yamada, 2025). This contributes to the analysis of GenAI-supported writing by showing that sequence-level behavioral patterns can complement correlation and regression results when examining revision processes in an SRL-informed instructional design.

5. Conclusion and Future Research

This study examined changes in writing performance and SRL awareness in a GenAI-supported EFL writing course. Results demonstrated that integrating SRL scaffolding within GenAI feedback significantly enhanced writing performance and learners' intrinsic value. Quantitative analyses revealed submission frequency uniquely predicted writing outcomes after controlling for baseline proficiency. Additionally, behavioral analyses indicated greater improvement was associated with linking reflective and monitoring behaviors to concrete revision actions. These findings illustrate that revision structure, in addition to frequency, drives writing development within SRL-informed designs. Limitations include self-reported measures and a localized beginner sample. Future studies should use fine-grained methods like epistemic network analysis to clarify regulatory processes during revision. Studies involving diverse proficiency levels and contexts are necessary to enhance generalizability. Such investigations will contribute to developing GenAI-supported writing systems that more effectively promote SRL and autonomous learning.

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