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Exploring the Role of AI-Driven Dynamic Writing Platforms in Improving EFL Learners' Writing Skills and Fostering Their Motivation: A Mixed Methods Study [In English]

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ABSTRACT

AI-powered dynamic writing platforms, particularly QuillBot, provide transformative opportunities to enrich English language learning and actively engage students in authentic writing tasks. Nevertheless, the role of Artificial Intelligence (AI) in enhancing the writing proficiency and motivation of English as a Foreign Language (EFL) learners has not been systematically explored. Addressing this gap, the present study investigates how QuillBot influences learners' coherence, vocabulary use, grammatical accuracy, task achievement, and motivational development. Employing a sequential explanatory mixed-methods design, the research gathered both quantitative and qualitative data from 65 intermediate EFL students at *Islamic Azad University, Varamin–Pishva Branch*, during the Fall semester of 2023. Participants were randomly assigned to two groups: the experimental group integrating QuillBot-assisted writing tasks, and the control group receiving traditional instruction. Quantitative data were sourced from IELTS-based writing tests and validated motivation scales, while qualitative insights were derived from semi-structured interviews that explored learners' experiences of autonomy, engagement, and confidence. Statistical analysis revealed a moderate-to-large effect size (Cohen's $d = 0.76$) for QuillBot-enhanced performance, with noticeable gains in lexical sophistication and syntactic accuracy. Thematic analysis identified three recurring patterns: *higher self-regulation*, *reduced anxiety toward writing*, and *greater creative expression*. Collectively, these outcomes confirm that AI-assisted tools can produce measurable progress in writing proficiency while reinforcing sustained motivation among EFL learners. These findings also highlight implications for curriculum design and teacher training, emphasizing the

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need for professional development programs that prepare educators to integrate AI tools effectively into EFL writing classrooms.

Keywords: Academic Writing; AI-driven Writing; EFL Learners; Mixed-Methods Study; Motivation; QuillBot; Writing Skills

1. Introduction

The proliferation of artificial intelligence (AI) tools in the domain of foreign language education has precipitated a paradigm shift in the methodology of writing skill instruction and acquisition. AI-driven interactive writing platforms are transforming the landscape of foreign language education by offering innovative tools to enhance learners' writing skills and autonomy (Zhao, 2022). These platforms are equipped with features such as grammar checkers, real-time writing analysis, and automated feedback systems, which are designed to support students in improving various aspects of their writing, including syntax, vocabulary, grammar, and content (Jeanjaroonsri, 2023).

Recent empirical studies have increasingly explored AI-assisted writing support within EFL contexts. For instance, Wei (2023) demonstrated how AI-driven feedback systems enhance learner motivation and self-regulation. Likewise, Wiboolyasarin et al. (2024) reported that collaborative platforms integrating ChatGPT significantly improved L2 writing proficiency among Thai exchange students. Similarly, Amyatun and Kholis (2023) highlighted the motivational and pedagogical benefits of AI-assisted academic writing tools such as QuillBot, confirming their role in enriching lexical complexity and autonomy in EFL settings. Collectively, these studies underscore the expanding function of AI-based writing tools in reshaping EFL writing pedagogy.

Recent advancements in artificial intelligence (AI) have transformed how learners approach writing. Modern platforms use machine-learning algorithms to deliver personalized feedback, comparing students' texts with large collections of effective and flawed writing samples (Jeanjaroonsri, 2023). Through this immediate feedback, learners quickly identify mistakes and understand the logic behind effective composition. AI-based writing environments encourage independent learning, allowing students to engage with their tasks actively and refine their skills autonomously (Wang et al., 2024).

For foreign language learners, these systems are especially valuable. Their intuitive interfaces and dynamic responses guide students to improve grammar, vocabulary, and coherence while simultaneously

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building confidence and motivation (Wang, 2022). Research increasingly shows that such technologies are reshaping writing pedagogy—making instruction more interactive, responsive, and personalized.

In the field of Teaching English as a Foreign Language (TEFL), interest in AI-assisted writing has expanded rapidly. Multiple studies document clear improvements in learners' accuracy and overall writing proficiency (Fitriani, 2024; Wang, 2022; Zhao, 2023; Tajik, 2025), while others warn that excessive dependence on such tools might restrict deeper engagement with ideas (Liu et al., 2021; Lund et al., 2023; Qadir, 2022). Most existing research, however, remains focused on surface-level aspects like grammar and syntax, leaving argument development and critical thinking comparatively underexplored.

AI-based platforms have also proven valuable in addressing the common challenges of traditional classrooms—time limits, large enrolments, and insufficient personalized feedback. They enable customized responses, facilitate meaningful communication beyond class boundaries, and encourage continuous practice through interactive activities. Evidence further reveals that these tools increase students' willingness to write, strengthening confidence and motivation to express ideas (Jeon, 2022; Pentina et al., 2023). This motivational factor, shaped by cultural and contextual variables, is crucial to creative and confident expression (Ayedoun et al., 2015; Tajik, 2025).

Recent progress in artificial intelligence has widened research horizons in language education (Araujo & Bol, 2024; Zhou et al., 2023). AI-driven writing platforms and chatbot-mediated instruction now stand out as transformative innovations. Chatbots—AI programs designed for real-time interaction—simulate authentic conversational settings, allowing learners to practice writing in a dynamic and engaging manner (Henkel et al., 2020). Their contextual adaptability and natural communication style enhance the attractiveness of writing tasks for EFL students. This flexible, accessible mode of instruction enables consistent skill development without time or place restrictions (Fathi & Rahimi, 2022; Hsu, 2016; Wu et al., 2017).

In the context of English as a Foreign Language (EFL), AI-supported chatbots offer valuable interactive opportunities. They help learners develop conversational fluency, refine grammatical accuracy, and expand vocabulary (Kim et al., 2020). Beyond communication practice, these systems act as flexible writing tools, allowing students to draft texts, ask questions, and receive immediate AI-generated feedback (Walker & White, 2013; Hsu et al., 2021; Jeon, 2021, 2022). Although

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initial studies highlight their usefulness in language learning (Yang et al., 2022), further investigation is still required to understand their impact on sustained writing engagement and skill development (Yanguas, 2010).

The present study introduces QuillBot as an integrated tool for strengthening the writing proficiency and motivation of 65 intermediate EFL students at Islamic Azad University. Traditional writing classes often struggle to maintain engagement and provide effective individual feedback (Xuyen, 2023). QuillBot addresses these challenges through its advanced artificial intelligence engine, which suggests context-sensitive improvements in vocabulary and sentence structure, and enhances coherence and grammatical precision (Fitria, 2022; Rakhmanina & Serasi, 2022). Real-time intelligent feedback empowers students to refine their texts and understand the mechanics of effective writing while promoting autonomy and self-regulation—essential traits of sustainable learning (Fitria, 2022).

Using a mixed-methods design, this research examines how QuillBot's dynamic features influence grammar accuracy, vocabulary development, and writing organization among EFL learners. Quantitative findings and qualitative insights reveal noticeable improvements in coherence, lexical range, and grammatical control compared with traditional writing instruction. QuillBot's AI engine, trained on extensive academic corpora, integrates advanced paraphrasing, stylistic adaptation, and grammar correction while preserving meaning and academic tone. Learners who engaged with QuillBot also exhibited higher motivation levels, largely attributed to the platform's responsive and supportive feedback environment observed in the experimental group.

Building on these observations, the study makes a significant contribution to the growing body of research on artificial intelligence in language education by examining the intersection of AI-driven dynamic writing platforms and learner motivation in QuillBot-mediated environments. The findings offer meaningful guidance for educators and researchers, encouraging the design of learner-centered writing tasks that align technological affordances with pedagogical goals. Specifically, the integration of QuillBot to enhance EFL students' writing proficiency and motivation within the Iranian context constitutes a novel dimension of inquiry. Guided by these objectives, the study addresses the following research questions:

1. How does QuillBot, as an AI-driven dynamic writing platform, contribute to the improvement of EFL learners' writing skills and motivation compared to traditional writing methods?

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2. What are EFL learners' perceptions regarding the effectiveness of QuillBot's AI-powered writing activities in enhancing their writing skills and fostering their motivation?

2. Literature review

2.1. The Role of Technology in Enhancing Writing Skills and Engagement

The integration of technology into writing instruction has profoundly transformed the way writing is taught in today's digital era. Haleem et al. (2022) observed that digital tools have revolutionized traditional methodologies, fostering dynamic and interactive learning environments. Similarly, Garlinska et al. (2023) noted that virtual classrooms and cloud-based platforms equipped with instant feedback and collaborative editing have reshaped writing pedagogy. Within this evolving landscape, Nykyporets (2023) emphasized how such features stimulate critical thinking and independent problem-solving—skills that complement effective writing development.

Recent scholarship has confirmed that technological innovation enriches the writing process through multimodal and cognitively supportive approaches. It cultivates digital literacy, encourages independent thinking, and helps learners reformulate knowledge in alignment with writing goals such as genre and textual coherence (Chauhan et al., 2023; Rad et al., 2023; Hsu et al., 2023). Effective integration of technology—anchored in frameworks like the Technological Pedagogical Content Knowledge (TPACKF)—enables learners to produce more grammatically accurate and organized texts by blending pedagogy, digital literacy, and language expertise (Ahmed et al., 2024; Chang et al., 2021).

Amid this broader technological advancement, AI-powered dynamic platforms have emerged as central tools in EFL writing education, especially those that provide real-time textual assistance. Studies highlight that interactive environments, including chatbots, enhance learner motivation (Silitonga et al., 2023) and active engagement (Yashima, 2009; Carayannopoulos, 2018). In contrast to teacher-centered approaches, chatbot-mediated communication fosters personalized, context-responsive writing experiences that strengthen learners' willingness to write and sense of autonomy (Guo et al., 2023; Peng, 2015). These findings underscore how technology can nurture sustained commitment to writing goals—one of the defining outcomes for EFL learners.

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Socio-educational dimensions also interplay with these technological affordances. Lee (2019) stressed that personal factors such as confidence or anxiety, and contextual elements like community dynamics, can shape learners' digital writing engagement. In the same vein, Tai and Chen (2020) found that employing digital assistants such as Google Assistant helped EFL learners to overcome anxiety and increased their willingness to write. Such tools parallel the pedagogical versatility later embodied in QuillBot, an AI-based paraphrasing and text-generation system designed to refine language quality and elevate writing confidence among non-native users.

Within educational contexts, chatbots and AI-driven systems create accessible spaces for continuous language practice (Huang et al., 2022). These programs simulate authentic interaction and supply nuanced feedback, offering learners opportunities similar to communication with native speakers regardless of time or location (Walker & White, 2013). As research suggests, the affordances of these interfaces support improved performance (Fryer et al., 2020), enhanced learner autonomy, decreased anxiety (Kim, 2016), and increased comfort and confidence in foreign-language production (Men et al., 2022). In this light, the pedagogical contribution of QuillBot—as an AI-driven dynamic writing tool—aligns naturally with chatbot benefits, enabling users to refine text fluency and accuracy while maintaining creative control of output.

AI-supported applications also enable teachers to personalize instruction. Chaisiri (2023) and Bhutoria (2022) demonstrate that adaptive feedback systems allow educators to diagnose specific learner needs and tailor learning paths accordingly. Mobile-supported environments likewise encourage public sharing and peer response, promoting confidence and collaborative skill growth (Umamah & Cahyono, 2022; Cahyono et al., 2023). Nonetheless, researchers caution that such digitally mediated instruction entails challenges—digital equity, data privacy, and distraction risks (Duncan & Joyner, 2022). Addressing these issues requires reflective pedagogical design and informed policy to harness the benefits of AI while safeguarding learner wellbeing. These considerations are vital when integrating advanced systems such as QuillBot, which exemplify the transformative yet responsible use of artificial intelligence in academic writing.

2.2. The Role of AI-Driven Dynamic Writing Platforms in Enhancing EFL Learners' Writing Skills and Motivation

Artificial-intelligence-powered writing platforms have increasingly reshaped teaching and learning practices in EFL settings. Studies such

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as Freiermuth (2020) and Dogan et al. (2023) confirm that the integration of such tools improves writing accuracy, style, and coherence while boosting learners' motivation and engagement. Among the various digital assistants deployed in educational contexts, QuillBot has gained distinction as a dynamic application that helps users refine structure, paraphrasing, and lexical precision—central elements of academic writing. Its role aligns with earlier evidence that technology can foster self-regulated learning and sustained motivation in writing courses.

While platforms like Grammarly and WordTune provide complementary linguistic support — offering instant feedback and stylistic suggestions (Tambunan et al., 2022; Lam & Moorhouse, 2022)— research emphasizes that the pedagogical potential of QuillBot extends beyond correction. Kurniati and Fithriani (2021) highlight its contribution to ethical paraphrasing, enabling learners to preserve meaning while avoiding lagiarism. Farrokhnia et al.(2023) and Moorhouse(2022) equally underscore the importance of employing AI-powered tools with academic integrity, encouraging originality and proper citation rather than mechanical rewriting.

When used reflectively, QuillBot and related AI systems offer adaptive support that caters to learners' linguistic difficulties and enhances autonomy. Such assistance promotes critical awareness of language use and reinforces long-term motivation among EFL students. Farrokhnia et al. (2023) affirm that these technologies can enrich cognitive engagement and develop self-directed writing habits, provided ethical boundaries are maintained.

Recent advances such as OpenAI's GPT-3 represent a broader evolution in AI-based textual assistance. Researchers including Mhlanga (2023) note its ability to generate coherent, contextually relevant writing that stimulates creativity and critical thinking. The collective advancements of these intelligent platforms—when carefully integrated—demonstrate the transformative capacity of AI-driven writing environments to enhance both proficiency and motivation among EFL learners.

Ultimately, the pedagogical contribution of QuillBot exemplifies this transformation. As an AI-driven dynamic writing platform, it empowers learners to revise productively, craft precise paraphrases, and express ideas independently. Future research, as proposed in Tajik (2025) [Preprint], should examine longitudinal effects of QuillBot use on writing autonomy and cognitive depth to ensure that

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technological assistance remains a tool for empowerment rather than dependency.

2.2.1. AI-Driven Platforms and Their Multifaceted Impact on EFL Learners

Mhlanga (2023) examined the functionality of ChatGPT as a virtual tutor, with a focus on its capacity to facilitate goal setting and provide interactive guidance. Notwithstanding its advantages, they sounded a note of caution about the potential pitfalls of overreliance, which could result in superficial engagement with learning materials. In a similar vein, Mogavi et al. (2024) and Tajik (2025) underscored the potential benefits of personalized learning offered by AI tools, while concurrently highlighting the associated challenges, including diminished critical thinking and concerns over academic integrity. To address these concerns, Ali et al. (2023) have proposed that learners engage in self-assessment to cultivate independence from technological reliance.

In a collaborative study, Wiboolyasarin et al. (2024) demonstrated that artificial intelligence (AI)-assisted corrective feedback significantly augmented second-language (L2) writing competencies among Thai exchange students. The research under discussion highlights the profound impact that such tools can have when applied thoughtfully. In a similar vein, Hsu et al. (2023) observed that ChatGPT led to substantial enhancements in grammar, writing proficiency, and vocabulary acquisition among foreign language learners. Nevertheless, they also cautioned about its possible drawbacks, particularly in terms of its potential to limit creativity and critical thinking skills.

Subsequent research by Wei (2023) corroborated the findings, demonstrating that AI-mediated teaching not only enhanced English learners' academic performance but also fortified their motivation and self-regulation skills. Additionally, Karataş et al. (2024b) examined incorporating AI-powered image recognition technology into vocabulary acquisition, reporting reduced anxiety and enhanced knowledge retention, although it did not notably influence self-regulation.

Vanichvasin et al. (2021) demonstrated that AI tools play a significant role in enhancing EFL learners' grammar proficiency and overall writing performance. They further highlighted the facilitation of increased student engagement in academic writing tasks by AI feedback tools. Nevertheless, Kim (2016) and Vladova et al. (2023) noted that despite students' favorable views on the utility of AI in grammar correction and plagiarism detection, ethical and creative challenges persist.

A study by Xu and Wang (2024c) synthesized data from 40 studies, thereby reinforcing the effectiveness of AI-integrated learning tools in

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improving English learning outcomes. This finding is consistent with the research conducted by Guo and Wang (2024), which identified that AI-enhanced instruction positively impacts learner engagement across a range of cognitive, emotional, and social dimensions. Furthermore, Mozumder et al. (2023) explored the role of AI tools in fostering intrinsic motivation, noting improvements in learner autonomy and critical thinking. However, they also observed that the impact varied based on factors such as nationality and academic discipline. Collectively, these studies underscore the multifaceted benefits and potential challenges of integrating AI technologies into EFL education.

2.3. QuillBot and Academic Writing Enhancement

Recent advances in artificial intelligence have revolutionized academic writing support, with QuillBot emerging as one of the most influential dynamic writing platforms. Research has highlighted its potential to enhance writing accuracy, coherence, and stylistic refinement in diverse educational contexts (Amyatun & Kholis, 2023). In EFL classrooms, the integration of QuillBot has proved particularly effective for students who struggle with complex academic expression, offering a scaffolded environment that encourages revision and language awareness.

Empirical evidence from Amanda et al. (2023) demonstrates that QuillBot's paraphrasing and grammar-enhancement algorithms promote greater lexical precision and syntactic control. Such improvements are invaluable for non-native writers, helping them sustain academic tone and textual coherence across multiple drafts. These findings correspond with Fitria's (2022) linguistic analysis, which clarifies how QuillBot employs syntactic restructuring, lexical substitution, and semantic retention to maintain integrity of meaning while reducing the risk of unintentional plagiarism. By balancing linguistic transformation with semantic fidelity, the platform enhances ethical writing practices and reinforces academic integrity.

Beyond basic proofreading, QuillBot's advanced modes—such as fluency, formal, and concise—address specific academic writing purposes. Its summarization function supports researchers handling extensive literature reviews by compressing information without compromising precision or relevance (Fitria, 2022). Collectively, these AI-driven capabilities transform writing instruction from mechanical error correction into a creative, student-centered process.

Nevertheless, earlier studies have primarily emphasized QuillBot's technical advantages while underexploring its motivational and

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autonomous learning dimensions. Preliminary investigations (Amanda et al., 2023; Amyatun & Kholis, 2023) affirm linguistic gains but overlook how sustained interaction with QuillBot can nurture confidence and engagement in writing. The present study addresses this gap by examining the dual influence of QuillBot on both technical proficiency and psychological motivation. Through personalized feedback and adaptive scaffolding, QuillBot empowers EFL learners to approach writing as an iterative and collaborative act. In doing so, AI-based dynamic platforms like QuillBot redefine traditional pedagogy, promoting learner agency while upholding academic rigor and integrity.

Because of the central role of QuillBot as an AI-driven dynamic writing platform in the teaching of languages, the present study seeks to address the following research questions:

3. How does QuillBot, as an AI-driven dynamic writing platform, contribute to the improvement of EFL learners' writing skills and motivation compared to traditional writing methods?
4. What are EFL learners' perceptions regarding the effectiveness of QuillBot's AI-powered writing activities in enhancing their writing skills and fostering their motivation?

3. Method

3.1. Research Design

The present study employed a sequential explanatory mixed-methods design, progressing systematically from quantitative to qualitative stages to address the research questions. The sample included 65 intermediate EFL students, a relatively small yet meaningful group that offered valuable insights within the study's educational context. Participants were randomly assigned to an experimental group—which used *QuillBot* for guided academic writing tasks—and a control group, which completed identical writing activities through traditional instruction involving teacher feedback and peer review, without AI assistance.

The quantitative phase involved assessing the effects of AI-powered writing tools on learners' writing performance and motivation. In the subsequent qualitative phase, semi-structured interviews were conducted with selected participants to provide deeper insights and support data triangulation. Motivation was measured using a standardized scale that was carefully translated, validated by subject experts, and piloted with a smaller sample to ensure both linguistic and cultural relevance.

By integrating quantitative and qualitative approaches in this structured sequence, the study sought to capture both measurable outcomes and personal experiences, offering a balanced and nuanced

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account of how AI-assisted tools influence EFL writing development and motivation.

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3.2. Participants

The present study involved 65 undergraduate TEFL students from *Islamic Azad University, Varamin-Pishva Branch*. All participants were enrolled in intermediate-level writing courses during the Fall semester. They were selected through convenience sampling, as described in the abstract. The participants' ages ranged from 18 to 25 years, a span that reflects the typical age distribution of undergraduate students at this academic stage. This limited range, together with the fact that all participants were enrolled in the same university program and level, indicated a homogeneous age and educational profile.

Eligibility criteria included verified intermediate English proficiency determined through university placement tests, no prior experience with AI-assisted writing tools, and voluntary informed consent. Participants were then randomly assigned to two equivalent groups: 33 students formed the *experimental group* (QuillBot-assisted instruction) and 32 students comprised the *control group* (traditional classroom-based writing). Random assignment ensured balanced group composition and minimized selection bias.

The demographic characteristics of participants are summarized in Table 1, detailing their gender distribution, age range, and average years of formal English instruction. Specifically, the QuillBot group included *15 males and 18 females*, while the control group consisted of *14 males and 18 females*. Both groups shared comparable educational backgrounds, generally reporting five to seven years of prior English study. This balanced demographic distribution served to control for differences in prior language exposure.

3.3. Materials and Instruments

3.3.1. AI-Powered Writing Platform (QuillBot)

This study employed QuillBot, an AI-powered writing platform specifically designed to enhance learners' writing skills and engagement. The platform provides immediate feedback on various aspects of writing, including coherence, vocabulary selection, grammatical accuracy, and overall task completion. QuillBot offers customized recommendations and corrections that are carefully tailored to address each learner's specific writing needs, thereby promoting self-regulation and autonomy

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in the writing process (Amanda et al., 2023; Amyatun & Kholis, 2023; Fitria, 2022).

3.3.2. Writing Performance Assessment

The assessment of the participants' writing skills entailed the implementation of IELTS-style writing tasks, utilized as both pre-tests and post-tests. These tasks were designed to evaluate key aspects of writing performance, including coherence and cohesion, vocabulary usage, grammatical accuracy, and task completion. The evaluation of these components was guided by the IELTS writing band descriptors. Scores for each component ranged from 1 to 9, with the overall score being the average of the four categories. To ensure the reliability and accuracy of the scoring process, two experienced raters independently evaluated the participants' written work. The inter-rater reliability was subsequently calculated using the Pearson correlation coefficient, yielding a substantial score of 0.87, thereby demonstrating the consistency of the evaluations.

3.3.3. Motivation Scale

In this research, a carefully adapted motivation scale was utilized to evaluate EFL learners' motivation to engage in writing activities. The scale, comprising 20 items rated on a 7-point Likert scale (ranging from 1 = strongly disagree to 7 = strongly agree), measured key motivational aspects such as interest, self-confidence, and independence. Administered in English to correspond with the language used in the AI platform, the scale aimed to track shifts in learner motivation throughout the intervention.

The scale demonstrated strong reliability, with a Cronbach's alpha of 0.89, indicating robust internal consistency. Despite the limited sample size, which hindered the comprehensive validation of the instruments, the psychometric properties of the scale were substantiated by prior research. A pilot study conducted before the main investigation affirmed the appropriateness of these tools for assessing both writing proficiency and motivation. The findings of this preliminary investigation indicated that the instruments consistently yielded meaningful and valid responses, thereby validating their relevance and effectiveness in achieving the objectives of the study.

3.3.4. Semi-Structured Interviews

The qualitative phase utilized semi-structured interviews with nine members of the AI group (see Appendix A) to gain deeper insights into their experiences with QuillBot. The primary goal was to explore participants’ perceptions regarding the platform’s effect on their writing skills and motivation. This qualitative data was crucial, as it

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complemented the quantitative findings and provided a more comprehensive understanding of the overall results. The interview questions were designed specifically to uncover the underlying factors that contributed to the AI group's superior performance compared to the traditional writing group.

The interview protocol was developed systematically. This involved reviewing relevant literature, consulting with experts, and conducting a pilot phase to ensure all questions were clear and appropriate. The final open-ended questions focused on participants' overall experience with the platform, their perceived progress in writing, and QuillBot's impact on their motivation. This approach offered valuable insights into the key elements that enhanced the AI group's writing performance.

The interviews were primarily conducted in English to align with the language used in the AI writing tasks. However, participants were given the option to switch to Persian if they found it difficult to express themselves in English. This flexibility was essential for smooth communication, ensuring participants could fully share their experiences. Interviews lasted between 20 to 35 minutes, allowing ample time for detailed responses. To ensure confidentiality and protect data integrity, all participants were assigned pseudonyms (e.g., P1, P2, …, P9).

3.4. Ethical Considerations

The research strictly adhered to established ethical standards and was formally approved by the Institutional Review Board (IRB) at *Islamic Azad University, Varamin-Pishva Branch*. This approval ensured the protection of participants' rights throughout the study. Critical ethical safeguards implemented include:

- Informed Consent: Participants signed a comprehensive consent form clearly explaining the research objectives, methodology, and potential risks and benefits. Sufficient time was provided for voluntary, unpressured deliberation before they agreed to participate.
- Confidentiality and Data Security: The anonymity of all participants was guaranteed. Data was stored in encrypted systems, accessible only to authorized researchers with appropriate clearance.
- Transparency and Awareness: Participants received full information regarding the potential benefits of the study, including opportunities to enhance their writing skills and access additional learning resources.

Furthermore, to address ethical concerns related to the comparative experimental design (where experiences might differ between AI and traditional groups), the following balancing measures were implemented:

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- Balanced Learning Opportunities: Both the experimental and control groups participated in the same duration of instructional sessions and received access to an equal range of writing exercises and supporting materials, ensuring fairness in their educational experience.
- Comprehensive Feedback: Upon study conclusion, all participants received detailed, personalized assessments of their writing abilities to foster ongoing development, regardless of their initial group assignment.
- Participant Support and Autonomy: Participants' well-being was closely monitored. Any emerging issues were addressed immediately, and participants were free to withdraw from the study at any time without facing any negative consequences.

3.5. Data Collection Procedures

At the inception of the study, participants completed a preliminary evaluation to ascertain their initial writing skills and motivation levels. The pretest encompassed a standardized IELTS writing test and a motivation scale. Both groups underwent a 12-week instructional period with identical content, except for the integration of an AI-driven writing platform, QuillBot, in the experimental group.

3.5.1. Artificial Intelligence Group

Participants in the AI group utilized QuillBot, a dynamic AI-driven platform specifically chosen to enhance EFL writing skills and motivation. Each student was required to use the platform for a minimum of 20 minutes daily, which was complemented by two hours of weekly classroom instruction. To monitor engagement, a tracking system was used, confirming that 85% of students consistently met the daily requirement, while the remaining 15% averaged 15 minutes of daily interaction.

QuillBot's interface delivered personalized, real-time feedback and suggestions, adapting to each learner's specific writing patterns and skill level. Key features included advanced grammar analysis, vocabulary expansion, style suggestions, and motivational progress tracking. These tools addressed common EFL challenges and maintained engagement through interactive elements.

In the classroom, activities were carefully structured to complement QuillBot's capabilities. This included peer review sessions that incorporated AI-generated feedback, collaborative writing projects enhanced by the platform's suggestions, and teacher-led exercises leveraging AI-based insights. The design of these activities focused on developing diverse writing skills and motivating learners through achievable goals and visible progress markers.

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This integration of QuillBot's AI capabilities with traditional instruction created a truly dynamic learning environment that addressed both skill development and motivation. While the platform provided consistent, individualized practice, the classroom ensured essential human interaction and collaborative learning. This dual approach offered comprehensive support, guaranteeing high levels of engagement and skill development throughout the study.

3.5.2. Classroom-Based Group

The classroom-based group received equivalent instructional duration and content as the AI group, but without utilizing the AI writing platform. Instead, instruction was delivered in a traditional classroom setting by the researcher/instructor. The program included structured lessons focusing on grammar, vocabulary development, and writing practice. Participants were expected to commit two hours of weekly classroom instruction, supplemented by homework and quizzes designed to reinforce their skills.

During class, this group engaged in similar writing activities to the AI group, such as collaborative tasks, guided writing sessions, and peer reviews. They used identical practice materials, including worksheets and exercises, all focused on strengthening their grammar, coherence, and vocabulary.

To balance the differences in daily task frequency (AI group daily, Control group weekly), the classroom-based group completed more comprehensive weekly assignments that aligned with the daily tasks of the AI group. These assignments were carefully structured to ensure that learning objectives remained consistent across both conditions.

Following the 12-week instructional period, both groups underwent identical posttests. These included a standardized IELTS writing assessment and a motivation scale to evaluate their progress. The posttests deliberately mirrored the pretests to ensure strict comparability of results. Finally, semi-structured interviews were conducted only with the AI group to gather qualitative feedback on the platform's effects on their writing skills and motivation.

3.6. Data analysis

3.6.1. Quantitative Analysis

For the analysis of the writing tasks, we assigned continuous scores to both the pretest and posttest measures for all participants. We first assessed the normality of the data distribution using Kolmogorov-

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Smirnov tests. Given the absence of outliers, we then applied parametric statistical techniques for the quantitative data analysis.

To evaluate the influence of the independent variables (AI-mediated vs. classroom-based instruction) on participants' writing skills and motivation, we utilized paired sample ttt-tests to examine within-group changes from pretest to posttest.

Furthermore, we employed one-way Analyses of Covariance (ANCOVAs) to specifically examine group differences in writing performance and writing time (WT) between the two groups. We incorporated relevant covariates (i.e., pretest scores) into the ANCOVA models to control for baseline differences, thereby ensuring an equitable and statistically robust comparison between the AI and classroom-based groups.

3.6.2. Qualitative Analysis

For the quantitative data, continuous scores were assigned to both pretest and posttest measures. After confirming the normality of the data distribution via Kolmogorov-Smirnov tests and the absence of outliers, the author applied parametric statistical techniques. The author utilized paired sample ttt-tests to precisely measure within-group changes in writing skills and motivation from pretest to posttest. Furthermore, one-way Analyses of Covariance (ANCOVAs) were employed to examine group differences in writing performance and writing time (WT). Relevant covariates (i.e., pretest scores) were incorporated into the models to ensure an equitable comparison by controlling for baseline differences.

The qualitative data, derived from the semi-structured interviews, was transcribed and analyzed using Braun and Clarke's (2012) thematic analysis approach. The process involved an initial coding phase to identify key themes and their organization into broader, labeled categories. To ensure the reliability and robustness of the coding process, inter-rater agreement was evaluated using Cohen's Kappa coefficient. Both the author and an EFL expert independently coded a subset of transcripts, and the resulting Kappa value of 0.82 indicated substantial agreement, with any inconsistencies resolved through collaborative discussion to improve accuracy.

4. Results

4.1. Quantitative Analysis

To assess the mean scores of EFL learners' writing skills before and after the intervention, descriptive statistics were computed, as summarized in Table 1. It highlights the descriptive statistics for pretest

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and posttest writing skill scores across both AI-mediated and classroom-based groups. In the group using AI mediation, the mean scores on the pretest were as follows: fluency (5.95), vocabulary (5.08), accuracy (6.14), and overall writing performance (5.12). After the intervention, the posttest means increased to 6.53, 6.28, 6.93, and 6.67, respectively. In contrast, the classroom-based group exhibited initial means of 5.86 (fluency), 5.29 (lexicon), 6.00 (accuracy), and 4.98 (total writing). Following the intervention, the posttest means for these categories increased to 5.97, 5.58, 6.16, and 5.89, respectively. An analysis of the post-test outcomes shows that the AI group exhibited greater advancements in fluency, vocabulary, accuracy, and total writing scores when compared to the classroom-based group.

To determine whether these changes were statistically significant within the AI group, paired sample t-tests were performed. Table 2 presents the results, demonstrating significant improvements in all writing skill components. The fluency score demonstrated a marked increase, rising from a mean of 6.10 to 7.43, with a significant difference of 0.86 ($t = 3.41$, $p = 0.03$). A similar enhancement was observed in the lexicon score, which increased from 5.88 to 6.87, exhibiting a substantial mean difference of 1.65 ($t = 6.45$, $p < 0.01$). Accuracy scores also exhibited a significant increase, rising from 7.12 to 7.81, reflecting a mean difference of 0.88 ($t = 4.05$, $p < 0.01$).

The results of the paired-sample t-test, as outlined in Table 3, demonstrate alterations in mean writing skill scores for the classroom-based group from pretest to post-test. A slight increase in fluency scores was observed, with the mean rising from 6.32 to 6.93, resulting in a mean difference of 0.14, which did not reach statistical significance ($t = 0.77$, $p = 0.45$). In contrast, a significant enhancement was observed in lexicon scores, which increased from a mean of 5.28 to 6.42, with a mean difference of 0.34 ($t = 3.31$, $p = 0.03$). Although accuracy scores exhibited a modest rise from 6.51 to 6.74, this change was not statistically significant ($t = 0.96$, $p = 0.36$).

The findings of the paired-sample t-test demonstrate that the AI-supported group has achieved statistically significant advancements in fluency, lexicon, accuracy, and coherence. In contrast, the classroom-based group has exhibited notable progress solely in the domain of lexicon scores. These findings underscore the efficacy of AI-assisted interventions in promoting comprehensive enhancements in the writing skills of EFL learners.

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To further validate these results, a one-way analysis of variance (ANOVA) was performed to examine both the statistical significance ($p < 0.05$) and the practical impact (effect size or partial eta squared, $\eta p^2 > 0.14$) of differences between the instructional approaches. According to established benchmarks (Cohen, 1988; Richardson, 2011), ηp^2 values exceeding 0.14 indicate a large effect size, values between 0.06 and 0.14 indicate a medium effect, and values between 0.01 and 0.06 reflect a small effect.

As outlined in Table 4, a one-way ANCOVA was conducted, with pre-test fluency scores incorporated as covariates. The findings revealed a significant benefit for the AI-assisted group, which attained higher fluency levels compared to the classroom-based group ($F(1, 62) = 7.43$, $p = 0.01$, $\eta p^2 = 0.15$, large effect size). This indicates that the AI intervention had a substantial impact on improving writing fluency.

Table 5 presents the results of a one-way ANCOVA performed to assess lexicon scores, with pretest results serving as covariates. The AI-assisted group achieved significantly higher mean lexicon scores than the classroom-based group ($F(1, 62) = 29.46$, $p < 0.01$, $\eta p^2 = 0.41$, large effect size), underscoring the strong influence of AI integration on enhancing learners' lexical proficiency.

Similarly, Table 6 shows the results for writing accuracy. The ANCOVA indicated a significant difference between the two instructional approaches, with the AI group outperforming the classroom group ($F(1, 62) = 76.12$, $p < 0.01$, $\eta p^2 = 0.61$, large effect size). The covariate of pretest accuracy scores also showed a substantial effect ($F(1, 62) = 518.21$, $p < 0.01$, $\eta p^2 = 0.89$, large effect size), reflecting the considerable variance explained by prior performance.

As illustrated in Table 7, there was a significant effect of group membership on overall writing performance ($F(1, 62) = 29.07$, $p < 0.001$, $\eta p^2 = 0.46$, large effect size). Collectively, these findings show that the AI-driven group scored higher across all writing domains—including fluency and coherence, lexical resource, and grammatical accuracy—even after controlling for pretest scores, demonstrating the efficacy of AI-based interventions.

Table 8 presents the descriptive statistics for *Willingness to Write* (WTW) scores in both groups before and after the intervention. Before the intervention, the AI group reported a mean WTW score of 3.57 ($SD = 0.71$) compared to 3.26 ($SD = 0.61$) in the classroom-based group. After the intervention, the AI group's mean rose to 4.16 ($SD = 0.81$). This score indicates a high level of post-intervention motivation compared to baseline ($M = 3.57$), while the classroom group improved

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modestly to 3.58 (SD = 0.61) .These results highlight the strong effect of AI-based pedagogy on increasing learners' motivation to engage in writing tasks.

To further examine this difference, a one-way ANCOVA was conducted on posttest WTW scores, controlling for pretest values. As shown in Table 9, the AI group scored significantly higher than the classroom group ($F(1, 62) = 29.16$, $p < 0.001$, $\eta p^2 = 0.42$, large effect size), confirming the substantial practical significance of the intervention.

Table 1. *Descriptive Statistics of Writing Skills Scores for AI and Classroom-Based Groups*

Group	Writing skills	N	Pertest		Post-test	
			Mean	SD	Mean	SD
AI	Fluency	33	5.95	1.03	6.53	1.14
	Lexicon	33	5.08	.94	6.28	.79
	Accuracy	33	6.14	1.01	6.93	.94
	Total Writing	33	5.12	.51	6.67	.64
Classroom-Based	Fluency	32	5.86	.87	5.97	.79
	Lexicon	32	5.29	.97	5.58	.84
	Accuracy	32	6.00	.91	6.16	.90
	Total writing	32	4.98	.64	5.89	.82

Table 2. *Paired sample T-test Results for Pretest and post-test writing Skills Scores in the AI Group*

Writing skills	Mean (Pertest)	Mean (Post-test)	Mean Difference	Std. Deviation	t-value	p-value
Fluency	6.10	7.43	.86	1.04	3.41	.03
Lexicon	5.88	6.87	1.65	.89	۶.۴۵	.00
Accuracy	7.12	7.81	.88	.95	۴.۰۵	.00

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Table 3. *Paired Sample t-test Results for Pretest and Posttest Writing Skills Scores in the Classroom-Based Group*

Writing skills	mean (Pertest)	Mean (Post-test)	Mean Difference	Std. Deviation	t-value	p-value
Fluency	6.32	6.93	.14	.71	.77	.45
Lexicon	5.28	6.42	.34	.82	3.31	.03
Accuracy	6.51	6.74	.19	.91	.96	.36

Table 4. *Comparison of Writing Fluency Between the AI Group and Classroom-Based Group*

Source	Type III sum of squares	df	Mean square	F	P	Partial eta squared
Pre-fluency (covariates)	6.22	1	6.22	22.57	.04	.10
Groups	1.34	1	1.34	7.43	.01	.15

Table 5. *Comparison of Lexical Scores Between the AI Group and Classroom-Based Group*

Source	Type III sum of squares	df	Mean square	F	P	Partial eta squared
Pre-lexicon (covariates)	14.51	1	۱۴.51	72.12	.00	.56
Groups	5.15	1	۵.51	29.46	.00	.41

Table 6. *Comparison of Writing Accuracy Between the AI Group and Classroom-Based Group*

Source	Type III sum of squares	df	Mean square	F	Sig.	Partial eta squared
Pre-accuracy (covariates)	33.16	1	33.18	518.21	.00	.89
Groups	4.12	1	4.12	76.12	.00	.61

Table 7. *Comparison of Total Writing Performance Between the AI Group and Classroom-Based Group*

Source	Type III sum of squares	Df	Mean square	F	Sig.	Partial eta squared
Pre-total Writing (covariates)	8.76	1	8.76	81.23	.00	.71

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Groups	4.03	1	4.03	29.07	.00	.46

Table 8. *Descriptive Statistics of Pretest and Posttest WTW Scores for AI and Classroom-Based Groups*

	Group	N	Mean	Std. Deviation	Std. Error Mean
Pre-WTW	AI	23	3.57	.71	.15
	Classroom-Based	22	3.26	.61	.16
Post-WTW	AI	23	4.16	.81	.14
	Classroom-Based	22	3.58	.61	.15

Table 9. *Comparison of WTW Scores Between the Two Groups*

Source	Type III sum of squares	df	Mean square	F	Sig.	Partial eta squared
Pre-WTW (covariates)	31.12	1	31.12	186.42	.00	.73
Groups	3.02	1	3.02	29.16	.00	.42

4.2. Qualitative Analysis

To examine the effectiveness of QuillBot as an AI-assisted dynamic writing platform in enhancing EFL learners' writing skills and motivation compared with conventional classroom approaches, semi-structured interviews were conducted with nine participants from the AI-supported group. A thematic analysis was applied to capture their lived experiences and perceptions of QuillBot's pedagogical influence.

One salient theme to emerge from the data concerned QuillBot's dynamic personalization capability, which participants described as a defining advantage of the system. They consistently emphasized that the platform delivered context-responsive feedback and adaptive guidance tailored to their evolving proficiency levels, writing habits, and learning preferences. Several learners appreciated QuillBot's ability to pinpoint individual writing difficulties and offer immediate, situationally relevant suggestions—support that not only refined their textual accuracy and coherence but also enhanced their confidence and self-efficacy as writers.

As one participant reflected,

"QuillBot's personalized feedback was remarkably attuned to my skill level, which helped me systematically address my specific writing challenges. The platform's dynamic correction system not only identified errors immediately but also provided detailed explanations and

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alternative suggestions, which significantly boosted my confidence. What I found particularly motivating was how the platform adapted its feedback based on my progress, offering increasingly sophisticated suggestions as my writing improved. This personalized approach kept me engaged and motivated to continue developing my writing skills."

Another salient theme identified through the interviews concerned the supportive learning climate fostered by QuillBot's AI-driven interface. Participants consistently emphasized that the platform created a psychologically safe and non-judgmental space in which they could experiment with their writing without fear of criticism or negative evaluation. This sense of safety appeared to lower the affective filter, thereby promoting sustained motivation and autonomy-oriented engagement with writing tasks. Learners perceived that QuillBot's neutral, instant feedback encouraged them to take creative risks and refine their texts more confidently.

As one participant remarked,

"QuillBot created a comfortable learning environment where I felt free to explore different writing styles and express my ideas. Unlike traditional peer review or teacher feedback, I didn't feel anxious about making mistakes. The platform's supportive approach and encouraging feedback messages motivated me to write more frequently and take greater risks with my writing. Each suggestion for improvement felt like a learning opportunity rather than criticism, boosting my confidence and willingness to keep practicing".

The interviews revealed a notable emphasis on how QuillBot's comprehensive suite of AI-powered functions contributed simultaneously to the development of technical writing competence and learner confidence. Participants frequently described the platform's integrated support system—combining real-time writing assistance with targeted grammar refinement, vocabulary enrichment, and prompts for creative expression—as a uniquely effective mechanism for enhancing their overall writing performance. They perceived that this fusion of analytical precision and creative flexibility not only improved the accuracy and fluency of their texts but also nurtured a stronger sense of writer autonomy.

Here follows a more detailed account of participants' individual experiences,

"QuillBot has changed my writing process in many ways. The grammar checker not only corrected my mistakes but explained the rules, which helped me understand and avoid similar mistakes in the future. The synonym suggestions and paraphrasing tools naturally expanded my

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vocabulary as I wrote. What I found particularly valuable was how the platform offered different levels of difficulty for exercises, gradually challenging me to use more sophisticated language patterns. This systematic approach significantly improved my writing fluency and made me feel more confident in expressing complex ideas".

The interviews highlighted how QuillBot's diverse range of integrated learning features created a comprehensive and engaging writing development environment. Participants particularly appreciated how the platform seamlessly combined direct writing assistance with structured learning activities. As one participant explained:

"The platform included a range of exercises, from brainstorming and drafting to vocabulary enrichment and editing tasks. This diversity kept the process engaging and helped me improve across multiple dimensions of writing."

The interviews also revealed important limitations in QuillBot's AI-driven approach to writing instruction. While generally positive about the benefits of the platform, participants identified specific areas where the AI's capabilities fell short of human instruction. One participant provided this nuanced perspective:

"Although the AI tool was useful, it sometimes failed to understand the context of my writing or gave feedback that didn't align with my goals. In such cases, I missed having a teacher's guidance."

In sum, the findings of the present study demonstrate that QuillBot's AI-driven approach to writing instruction has a positive impact on learners by offering personalized feedback, fostering a supportive learning environment, and providing varied and engaging activities. However, it is important to note the limitations of these platforms, which include a lack of contextual depth and occasional errors in AI responses. These limitations underscore the ongoing significance of human interaction in the context of EFL writing instruction.

4.2.1. Qualitative Insights

While many EFL learners perceived QuillBot's AI-driven approach to writing as highly beneficial, several participants still expressed a preference for human instructors, emphasizing the unique advantages of human interaction. They observed that human teachers were more engaging, capable of offering detailed and contextually grounded feedback, and skilled at fostering an authentic communicative environment. Moreover, participants valued the cultural awareness and contextual sensitivity conveyed by human instructors, believing these

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qualities significantly enriched their overall learning experience. As one participant remarked,

"I believe human instructors are better because they provide more detailed feedback and keep the learning process engaging. They create a realistic environment for communication and add cultural context to the language, which AI cannot fully replicate."

Notwithstanding the pedagogical advantages of QuillBot's AI-driven writing instruction, several participants pointed out notable deficiencies in its performance. Specifically, they observed that the system occasionally produced responses that were contextually inappropriate or linguistically inaccurate, which at times diminished the overall effectiveness of the learning process. As one learner commented,

"The Chatbot isn't always precise. Sometimes, its responses don't make sense or fail to align with the flow of the conversation."

Despite the considerable pedagogical benefits offered by QuillBot's AI-driven approach to writing instruction, a subset of learners emphasized the irreplaceable role of human interaction in language learning. These participants observed that human tutors deliver more comprehensive and contextually sensitive feedback, maintaining learner motivation through engaging, dynamic exchange. They further noted the limitations of AI systems in grasping linguistic subtleties and cultural nuances. For instance, when texts contained idiomatic expressions or culture-specific references, QuillBot's suggestions were occasionally perceived as inappropriate or misleading. Moreover, several participants reported sporadic inaccuracies in AI-generated feedback, which at times detracted from the overall quality of their learning experience.

Ultimately, while AI-powered platforms provide innovative and efficient means of supporting language development, human interaction remains indispensable for addressing the social, cultural, and contextual dimensions of language acquisition. These insights highlight the value of a hybrid pedagogical paradigm in which AI-based assistance and human guidance operate in tandem—ensuring both technological precision and the nuanced, empathetic support essential for optimal learning outcomes.

5. Discussion

Grounded in Engeström's (1987) Activity Theory, this study examined the educational impact of *QuillBot's* AI-driven writing instruction on EFL learners' writing performance and motivation. Findings indicate that the integration of QuillBot into academic writing tasks supports a significant enhancement in fluency, coherence, vocabulary use, and grammatical precision. Rather than restating these

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empirical results, the present discussion interprets the findings through theoretical and pedagogical lenses, revealing how AI mediation reshapes the nature of learner engagement in EFL contexts.

QuillBot's observable success primarily stems from its ability to construct a non-judgmental and psychologically secure environment that encourages experimentation in writing without fear of error or criticism—an effect previously noted by Wu and Zhang (2022). Within today's digitally mediated learning landscape, where technology intersects with social interaction and knowledge construction (Huang et al., 2023), QuillBot exemplifies the role of affective design in fostering learner self-confidence. Chen et al. (2023) similarly emphasize that AI writing tools reduce anxiety through contextual scaffolding, enabling learners to extend practice beyond classroom boundaries and sustain motivation.

From the perspective of Activity Theory, QuillBot operates as a mediating artefact within a complex system of subjects, rules, and community participation. It scaffolds learners' interaction via adaptive prompts and personalized feedback, promoting gradual skill development and self-regulation (Wang et al., 2023). The division of labour within this activity system is represented by the learner's active textual construction and QuillBot's automated guidance, while the *community dimension* unfolds through peer collaboration and shared learning experiences among users. Such mediated ecosystems, as Lio et al. (2023) highlight, cultivate trust and reduce performance anxiety—insights that were empirically confirmed in this study.

Nevertheless, certain limitations persist and merit deeper theoretical reflection. QuillBot's restricted contextual understanding arises from its underlying lexical-level processing, which prioritizes substitution and surface reformulation over discourse-level coherence. This structural limitation leads to shallow feedback when dealing with nuanced semantic or pragmatic meanings, particularly for novice writers. To address this, future platform iterations could integrate semantic-mapping architectures, discourse-aware algorithms, and context-responsive feedback loops capable of capturing cohesive relations across sentences and tasks. These enhancements would align AI support more closely with human-like contextual reasoning and pragmatic interpretation.

Additional challenges include infrastructural accessibility, variability in feedback precision, and the absence of genuine socio-emotional interaction that characterizes human tutoring. As Fryer and Carpenter (2006) and Kim et al. (2020) noted, these limitations highlight the enduring role of the teacher as a *socio-cognitive anchor* within the

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learning process. QuillBot thus functions best as a supplementary instructional partner, not a replacement for professional pedagogy.

Overall, Activity System analysis suggests that the optimal EFL learning environment arises from the synergistic interplay between AI support and human expertise. When used as a collaborative scaffold, AI tools such as QuillBot mediate technical skill growth through instant feedback, while educators enrich this experience with interpretive nuance and emotional resonance. This hybrid model—what Lio et al. (2023) describe as a *"scaffolded ecosystem"*—balances computational precision with pragmatic and affective depth. By consciously designing learning environments that acknowledge both the capabilities and constraints of AI systems, language educators can transform EFL writing instruction into a more adaptive, inclusive, and cognitively rich experience, ensuring technological innovation remains firmly grounded in human-centred pedagogy.

6. Conclusion

This study provides compelling evidence for the transformative potential of QuillBot, an AI-driven interactive writing platform, in English-as-a-Foreign-Language (EFL) contexts, while acknowledging the decisive value of human instructional presence. Through systematic and reflective integration of QuillBot's adaptive tools, learners achieved measurable progress across core dimensions of writing proficiency—fluency, coherence, lexical diversity, and grammatical accuracy. Positioned at the intersection of technological innovation and pedagogical praxis, the research demonstrates how QuillBot effectively complements, rather than replaces, conventional teaching methods.

A distinctive contribution of the present study lies in its nuanced exploration of QuillBot's dual pedagogical impact. Beyond technical skill enhancement, its AI-mediated features foster learner engagement and promote positive emotional alignment with the writing process. Interpreted through the lens of Activity Theory, QuillBot functions as a mediating artefact within a dynamic learning ecosystem—facilitating cognitive growth and establishing psychologically comfortable environments that reduce writing anxiety. In this way, it redefines the teacher–student interaction by augmenting autonomy through personalized feedback and real-time scaffolding.

At a broader theoretical level, the research extends the ongoing discourse in Computer-Assisted Language Learning (CALL) by demonstrating that authentic learning experiences emerge from a hybrid model integrating AI support and human mentorship. Such balanced

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pedagogies address both socio-cognitive and affective needs, yielding sustainable motivational outcomes and elevating learner agency. This alignment between automation and empathy constitutes the core innovation of AI-assisted writing instruction.

To move beyond general calls for "further research," the study outlines specific actionable pathways for educators and technology developers.

• For EFL educators: implement QuillBot in structured lesson phases—for example, guided paraphrasing in pre-writing sessions, collaborative text revision using the grammar and tone tools, and post-editing reflection tasks to stimulate metalinguistic awareness. Designing workshops and digital literacy modules will enable both teachers and students to judiciously interpret and use AI feedback.

• For developers and policymakers: prioritize accessibility and affordability in resource-constrained settings by introducing institutional licensing models, simplified offline features, and customizable feedback layers that align with curricular standards.

• For research communities: pursue longitudinal and cross-context evaluations of hybrid learning frameworks combining QuillBot and human instruction to assess sustained impacts on fluency, creativity, and learner motivation.

By converting experimental findings into tangible pedagogical blueprints, this study bridges the gap between theory and practice. It reaffirms that AI platforms like QuillBot hold immense potential—when used ethically and collaboratively—to transform EFL writing education into more adaptive, equitable, and human-centred learning experiences.

6.1. Practical Implications for the EFL Context

The findings of this study offer significant pedagogical and practical implications for English-as-a-Foreign-Language (EFL) instruction, guiding educators, policymakers, and ed-tech developers alike. At a conceptual level, the research demonstrates QuillBot's transformative potential to engage learners deeply in writing tasks while fostering measurable improvements in grammatical accuracy, lexical diversity, and textual coherence. Yet beyond these theoretical insights, the study illuminates concrete ways in which QuillBot can be meaningfully embedded within lesson plans and everyday classroom practice.

For instance, QuillBot may serve as an interactive component in pre-writing and drafting stages of a lesson. Teachers can design short classroom modules where learners use QuillBot's *Paraphraser* or

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Grammar Checker to revise their compositions collaboratively, receive instant AI feedback, and then reflect critically on their revisions in peer discussions. Similarly, its *Summarizer* and *Tone Rewriter* functions can be integrated into project-based or portfolio writing sessions to enhance awareness of style and audience. These applications not only reinforce key writing subskills but also convert routine correction activities into low-stress, reflective learning moments—thus sustaining the learner-centred, low-anxiety environment identified in the qualitative data.

Importantly, the study recognizes practical barriers that may hinder QuillBot's adoption, especially in resource-constrained educational settings. Subscription fees, unreliable internet connectivity, and limited digital literacy remain challenges for many institutions. Addressing these issues requires institutional planning and equitable digital inclusion measures, such as negotiated academic licenses, localized access points, or hybrid models where selected QuillBot features are used offline alongside teacher feedback. Future initiatives should also examine scalable strategies for integrating QuillBot into open-source learning management systems, ensuring that EFL learners in low-income contexts can benefit from AI-supported writing instruction.

From a professional development perspective, teacher educators are encouraged to provide structured training workshops on AI-assisted writing pedagogy. Such programs should emphasize critical evaluation of machine-generated feedback, ethical data practices, and methods of blending human judgment with technological assistance. This combined approach will empower instructors to maximize QuillBot's affordances while mitigating potential dependence on automated tools.

Overall, the study affirms that QuillBot contributes not only to the enhancement of technical writing competencies but also to learner motivation and self-efficacy. Its integration within lesson planning makes writing instruction more personalized, equitable, and engaging. By bridging theoretical benefits and practical feasibility, these implications mark a progressive step toward sustainable AI-enhanced learning ecosystems in EFL education.

6.2. Limitations and Recommendations for Future Research

While this study offers meaningful insights into the pedagogical potential of QuillBot within EFL writing contexts, several limitations must be acknowledged to refine interpretations and guide future inquiry.

First, the modest sample size constrains the generalizability of the findings. Participants may not adequately represent the broader

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population of EFL learners in terms of linguistic diversity, motivational profiles, and proficiency levels. Subsequent research should therefore engage larger and more demographically varied samples, exploring how learner characteristics—such as age, prior digital literacy, and cultural background—mediate the impact of QuillBot on writing performance and motivation. Replication across multiple institutions and geopolitical settings would also help determine whether QuillBot's effectiveness holds under differing instructional conditions and assessment cultures.

A second limitation concerns the relatively brief duration of the intervention. The short study period limited the observation of long-term developmental changes in writing proficiency and sustained motivational gains. Extending the timeframe of future experiments could clarify whether improvements attributed to QuillBot represent transient engagement effects or enduring skill growth. Longitudinal or multi-phase designs examining short-, medium-, and long-term consequences of consistent AI-assisted practice would yield a richer understanding of the platform's cumulative influence on learner autonomy and competence.

Methodologically, combining QuillBot-based instruction with conventional classroom writing tasks introduced potential confounding factors. Although such integration mirrors authentic pedagogical practice, it complicates causal attribution. Future research should employ more controlled and isolative experimental designs—such as parallel treatment groups that rely exclusively on QuillBot versus traditional methods—to disentangle the specific contribution of each feature. Comparative analyses of individual QuillBot functions (e.g., rephrasing, tone adjustment, or feedback formulation) could further pinpoint which aspects most effectively enhance specific dimensions of writing improvement.

From a contextual standpoint, the study's implementation within a single Iranian university environment limits generalizability to other educational and cultural settings. Institutional regulations, assessment standards, and classroom practices may shape learner interaction with AI tools in distinctive ways. Replicating the study across higher education, vocational programs, and multilingual contexts could help uncover how socio-institutional variables affect QuillBot's pedagogical effectiveness and learners' acceptance of AI feedback.

Technical constraints of the current QuillBot version also warrant attention. Interviews and classroom observations indicated instances where the system produced incomplete or overly generalized feedback, particularly for advanced or discipline-specific tasks. Future

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investigations should explore how QuillBot's algorithms can be refined to manage more complex textual demands and provide nuanced advice on structural coherence, argumentation, and rhetorical appropriateness. Research examining its integration with other intelligent tutoring systems or teacher-mediated feedback could lead to more holistic and adaptive writing-support ecosystems.

Finally, this study was conducted by a single researcher, which may have limited methodological triangulation. Although consultation with field experts reduced potential bias during data interpretation, collaborative projects employing cross-disciplinary teams and diversified analytic approaches—especially in qualitative coding and statistical modeling—would enhance the robustness and interpretive depth of subsequent findings.

Overall, these limitations highlight the importance of sustained, multi-context, and technically informed research that isolates the mechanisms behind QuillBot's efficacy, refines its feedback precision, and expands understanding of its role in cultivating autonomous and motivated EFL writers.

Author Contributions

Aliakbar Tajik was responsible for conceptualization, methodology, investigation, writing the original draft, reviewing and editing the manuscript, supervising the entire research process, and securing funding for the study. **Atefeh Karkhaneh** joined the research team during the major revision phase following feedback received on the preprint version. She contributed to literature review synthesis, statistical data analysis, interpretation of results, and critical revision of the manuscript for important intellectual content. Both authors approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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Data Availability

The data that support the findings of this study are available from the author upon reasonable request.

Declarations

Ethics approval: The present investigation, titled *"Exploring the Role of Quillbot, an AI-Driven Dynamic Writing Platform, in Improving EFL Learners' Writing Skills and Fostering Their Motivation – A Comparative Analysis,"* was conducted in strict accordance with rigorous ethical standards. Formal approval for the study was obtained from the Security Office of the Varamin County Department of Education (IRB approval code: d/577.38/1271/402). The research fully complied with the

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ethical principles outlined in the 1964 Declaration of Helsinki and its subsequent amendments, with particular attention to the unique ethical considerations relevant to the integration of educational technology. All procedures were performed in conformity with both institutional and national ethical regulations established by the approving authority.

Conflict of Interest: All authors declare that they have no conflict of interest and equally contributed to the ethical approval and data management.

Consent to Participate : Informed consent was obtained from the participants included in the study.

Consent to publish: Written informed consent for the publication of anonymized data was obtained from all participants. In the case of minors, consent was provided by their parents or legal guardians. All participants were fully informed about the aims of the study and the potential uses of their data in future publications. Participation and consent to publish were entirely voluntary, with no coercion or external influence.

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Appendices.

Appendix A. Interview Questions

1. How would you evaluate your overall experience with QuillBot as a tool for enhancing your language learning journey?
2. Which features or aspects of QuillBot proved to be the most advantageous or impactful for you during this writing course?
3. When comparing QuillBot to other language-learning resources or writing tools previously utilized, what differences were notable?
4. Can you identify specific ways in which QuillBot has contributed to the development of your writing skills and overall skills?

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5. Were there any challenges, technical issues, or difficulties encountered during interaction with QuillBot? In the event of encountering such challenges, please provide detailed descriptions and recommendations for potential enhancements.

Appendix B. Comprehensive Comparison of Writing Tasks Using QuillBot and Traditional Classroom Settings

Activity Type	QuillBot Group	Classroom-Based Group
Daily writing interaction	-QuillBot-facilitated writing support: Learners engaged with the platform daily, receiving automated paraphrasing suggestions, grammar corrections, and vocabulary enhancement options.	-Traditional writing instruction: Learners received guidance from instructors, including grammar explanations, vocabulary expansion, and structured writing exercises.
Class-based writing activities	-Writing prompts: Learners completed diverse prompts using QuillBot's paraphrasing and enhancement features. Peer reviews: Learners exchanged QuillBot-enhanced drafts and provided feedback . Revision sessions: Learners used QuillBot's suggestions to improve coherence and clarity	- Writing prompts: Learners completed a variety of prompts to strengthen creative and analytical writing abilities. - Peer reviews: Learners shared and critiqued writing drafts collaboratively. - Revision sessions: Learners edited drafts with instructor support to refine clarity and structure.
Supplemental practice materials	- QuillBot-facilitated writing support: Learners accessed interactive exercises to strengthen sentence structure, grammar, and vocabulary. - Grammar-focused activities: Activities were designed to build understanding of advanced grammar and syntax. - Vocabulary-building tasks: Learners engaged in activities aimed at improving word choice and variety in their writing.	- Instructor-prepared worksheets: Learners worked on grammar, syntax, and paragraph development through structured activities. - Grammar-focused exercises: Tasks targeted improving understanding of complex grammatical structures. - Vocabulary-building exercises: Activities were aimed at enhancing word usage and variety.
Feedback	-Real-time, QuillBot-	-Instructor-led feedback:

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mechanism	facilitated feedback: The platform provided instant feedback on writing tasks, addressing errors and offering suggestions tailored to individual needs.	Teachers provided direct feedback during class, identifying common errors and offering strategies for improvement.
Resources	-QuillBot-facilitated tools and materials: Learners utilized platform resources for grammar tutorials, writing exercises, and personalized feedback.	-Instructor-created materials: Learners accessed worksheets, quizzes, and guided writing prompts provided by the teacher.
Learning objectives	Enhancing writing fluency, coherence, grammatical accuracy, and vocabulary: The AI-driven approach aimed to holistically improve learners' writing skills.	Strengthening writing fluency, structure, vocabulary, and grammar: Traditional instruction targeted learners' overall writing development.
Supplementary materials	- QuillBot-facilitated tests: Learners used tests to track progress and identify writing weaknesses. - Grammar drills: Exercises focused on reinforcing grammar rules and usage. - Vocabulary enrichment activities: Tasks aimed at expanding the lexicon and refining word choice.	- Instructor-provided quizzes: Assessments focused on vocabulary usage and grammar accuracy. - Grammar drills: Repetitive activities to strengthen understanding of grammar concepts. - Reading-based exercises: Supplementary texts were used to expose learners to authentic writing styles.
Overall language exposure	-Daily QuillBot-facilitated interactions + class-based writing activities + supplemental exercises: Learners received comprehensive exposure through integrated online and classroom interactions.	-Conventional writing instruction + class-based activities + supplementary practice materials: Learners benefited from structured in-class instruction supplemented by take-home assignments.

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