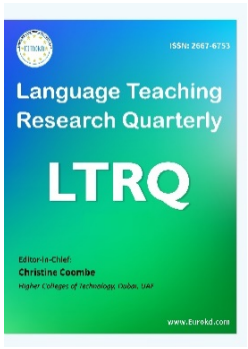

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The Effects of a QuillBot-Based Intervention on English Language Majors' EFL Writing Performance, Apprehension, and Self-Efficacy

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Abstract

Some recent studies have reported positive effects of artificial intelligence (AI)-powered writing assistants on students' EFL writing skills, but their impact on affective factors has yet to be examined. Thus, the present study investigated the effects of a QuillBot-based intervention on English Language majors' EFL writing performance, apprehension, and self-efficacy. The participants constituted 18 fourth-year students in the English Language Department, Faculty of Archaeology and Languages, Matrouh University, during the second semester of the 2023-2024 academic year. For six weeks, students performed in-class and out-of-class QuillBot-based activities where they collaboratively developed their first drafts, reviewed the AI-generated feedback, revised their writing, and wrote their final drafts. One test and two scales were administered before and after experimentation to measure the effects of the proposed intervention. Qualitative data was also collected from the students' reflective reports to gain deeper insights into their perceptions of the intervention in improving their writing and affective states. The results revealed that the QuillBot-based intervention had significant positive effects on students' writing performance, apprehension, and self-efficacy. The students also displayed largely positive perceptions toward it. Such results suggest that using QuillBot collaboratively can enhance writing performance, reduce writing apprehension, and promote writing self-efficacy among EFL learners.

Keywords: *QuillBot, Artificial Intelligence, AI, Writing Performance, Writing Apprehension, Writing Self-Efficacy*

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Introduction

Despite its importance for university students' academic achievement and future career (Connelly, 2013), writing is conceptualized as a complex, problematic, and affective process (Rahimi & Zhang, 2018), particularly for those undergraduates composing in their FL, thus facing several linguistic and pedagogical challenges (Hanauer et al., 2019). Students, therefore, struggle to fine-tune their writing skills in content, form, style, and tone. These difficulties may arise from negative affectivity manifested in having high writing apprehension levels with low writing self-efficacy beliefs. Many students are reluctant to write and lack confidence in their writing capabilities (Abdel Latif, 2015; McDuff et al., 2010). Considering this, collaborative writing tasks can be implemented to foster students' engagement, self-confidence, and writing development (Liu et al., 2022). Such tasks become most effective when employing learner-centered instruction, in which students actively engage in identifying and correcting mistakes in their writing while co-creating texts. Teachers then take on the role of facilitators, offering feedback and guidance to monitor the collaborative process (Wiboolyasarin et al., 2024).

Unfortunately, few efforts are being made to equip students for monitoring multiple student groups' writing and providing constructive feedback is often exhausting and time-consuming for university teachers and professors (Lim & Phua, 2019). Computer-based technologies, particularly artificial intelligence (AI) applications, are increasingly becoming efficient alternatives (Nazari et al., 2021) since AI gives machines "the ability to carry out functions that are normally associated with human intelligence, such as reasoning, self-correcting, and learning through experience" (Richards & Schmidt, 2010, p. 34). They are classified into automated writing evaluation (AWE) tools that generate automated real-time essay scores and personalized feedback (e.g. Criterion, Grammarly, Grammark) and digital writing assistant (DWA) systems that generate high-quality content and creative rewriting suggestions (e.g. iWrite, Rytr, Wordtune) through advanced machine learning (ML) and natural language processing (NLP) algorithms (Kim et al., 2023; Odo, 2024; Xia et al., 2022; Zhao et al., 2024), thus saving time and increasing teaching efficiency by allowing teachers to focus on other areas of instruction. Combining AI-based feedback with collaborative writing (the focus of the proposed intervention), which is not well-documented, represents an innovative techno-pedagogical approach aiming at revolutionizing language learning practices (Wiboolyasarin et al., 2024).

While numerous studies have extensively researched AWE, scanty studies have documented the effect of DWA tools on students' writing development (Odo, 2024; Xia et al., 2022; Zhao et al., 2024), overlooking their influence on students' affective states (Andriani et al., 2024; Bouzar et al., 2024). Therefore, the present study plugs this gap in prior literature by exploring the effects of QuillBot, a popular DWA application, on English Language majors' EFL writing performance, apprehension, and self-efficacy. It was chosen due to its compatibility, flexibility, and ease of use. It also provides AWE on its grammar checker beside the DWA affordances on its paraphraser and summarizer (Singh et al., 2024). Moreover, it visualizes the suggested modifications and offers credible explanations for the highlighted mistakes to improve students' writing skills and build their confidence in using them (Wallwork, 2024). Additionally, while few studies have investigated students' perceptions of QuillBot (Ha, 2023; Hieu et al., 2022; Kurniati & Fithriani, 2022), further investigations are

needed to get a better understanding of their views about the use of the tool, particularly with its impact on writing apprehension and self-efficacy.

Context of the Problem

English Language majors at the Faculty of Archaeology and Languages, Matrouh University, study two mandatory essay writing courses in the fourth year: Essay I and Essay II. Through observations of students' performance in classroom activities, home assignments, and final examination results, various writing problems were identified. Most students struggled to organize their ideas into coherent paragraphs and essays, develop a strong thesis statement and topic sentences, construct well-substantiated arguments, apply grammatical rules and mechanics, and choose suitable and varied vocabulary. They also experienced high levels of apprehension and low self-efficacy beliefs. These difficulties may be due to ineffective teaching and feedback practices, limited writing resources, insufficient time allotment, and L1 transfer into the FL (Ahmed, 2016). To document the problem, the researcher held semi-structured interviews with 14 fourth-year students during the second semester of the 2022-2023 academic year to explore their perceptions of writing which was believed to be one of the most important and difficult EFL skills. Concerning their ability to write effective essays, most respondents rated themselves as either average or below average. Regarding the affective variables, they perceived themselves as having either medium or high levels of writing apprehension and low self-efficacy. They were acclimatized to receiving instruction and delayed written feedback from their lecturers. They seldom practiced collaborative writing activities. They also indicated that the teacher-led feedback- provided as grades, comments, or suggestions- was insufficient to develop their writing quality. Besides, they did not clearly understand how to assess their written products through peer review. Thus, the present study was conducted to help students to enhance their writing performance, reduce their writing apprehension, and promote their writing self-efficacy through a QuillBot-based intervention. To direct the study, the following research questions were formulated:

RQ_1: What are the effects of the QuillBot-based intervention on English Language majors' EFL writing performance, apprehension, and self-efficacy?

RQ_2: What are the English Language majors' perceptions of the QuillBot-based intervention?

Literature Review

Writing Performance

Crusan (2013, p. 14) defines writing performance as "the students' ability to write coherent and effective essays". Similarly, Cheung (2016, p. 181) delineates it as "composing an effective piece of written work to fulfill a specific purpose". For Nelson and Schunn (2009), it is the writing quality gained from repeated tasks. To achieve such quality, students "need advanced control of the linguistic features (vocabulary, spelling, grammar, cohesive ties) and extralinguistic features (punctuation, capitalization, formatting) appropriate for the content, genre, and target audience for their text" (Ferris, 2018, p.75). Thus, writing performance involves the assessment of specific skills, including content fulfillment, organization development, vocabulary proficiency, grammatical knowledge, and mechanical accuracy. Content fulfillment evaluates how satisfactorily students can address an assigned topic. Proficient students convey their thoughts by developing relevant and substantial arguments

with detailed examples and explanations. Organization development evaluates how students can organize and develop their ideas in a logical flow. Competent students link textual elements within and between paragraphs by appropriate transition expressions. Vocabulary proficiency evaluates students' ability to use precise and varied lexical items. Skilled students use a wide range of sophisticated words and display a thorough understanding of word form and usage. Grammatical knowledge evaluates students' ability to apply English grammar rules, using different sentence structures with few linguistic errors. Mechanical accuracy deals with students' adherence to English academic writing conventions in terms of spelling, punctuation, and capitalization (Kim, 2011). Students also need to understand and follow the recursive writing process that features phases of researching, planning, drafting, revising, editing, proofreading, and sharing/publishing (Crusan, 2013).

Thus, students need effective pedagogical strategies for developing their writing skills and managing the procedures of the writing process which become more ingrained with experience. Written corrective feedback has been examined as a useful instructional tool that enhances students' writing performance and triggers revision (Lee, 2017). It provides students with a text-based, individualized, and contextualized response from the teacher, indicating their progress, offering suggestions for improvement, and engaging them in future assignments. Teachers, however, perceive it as an essential but laborious task (Ouahidi & Lamkhanter, 2020) due to the excessive workload and large class sizes (Ahmed, 2016; Sayed & Curabba, 2020). To lighten such feedback burden, research suggests using automated feedback, especially during the revision stage (Li, 2021; Zhang, 2020). Since collaborative processing of feedback elicits active engagement with the feedback offered and increases motivation for improvement (Wigglesworth & Storch, 2012), collaborative writing was therefore proposed to carry out the writing stages of the QuillBot-based intervention where students verbally interact, negotiate tasks, and make shared decisions to co-create a single written text (Storch, 2013) using QuillBot. Such synergy is mainly guided by the principles of Vygotsky's (1978) sociocultural theory which maintains that students' cognitive development is mediated by social interactions and cultural artifacts, involving advanced technological tools. To the researcher's knowledge, two studies have examined the impact of pairing AI feedback with collaborative writing on students' EFL writing performance. Odo (2024) explored how student-teachers collaboratively used the AWE software (LanguageTool) and the DWA tool (Wordtune) during an essay writing course. Students' post-reflections revealed that the AI feedback helped them to correct their grammar and word-choice errors and improve their writing quality through the immediate suggestions offered. Wiboolyasarin et al. (2024) employed a 10-week intervention on 39 Thai undergraduates using a structured three-stage process: wiki-based collaborative outlining, ChatGPT-empowered independent writing, and wiki-based collaborative writing to develop the final drafts. Post-testing findings indicated that the experimental group significantly outclassed the control group in EFL essay writing.

Writing Apprehension

Recognizing the impact of negative emotions, the affective domain is incorporated in Hayes' (1996, p. 5) writing model which assumes that writing "depends on an appropriate combination of cognitive, affective, social, and physical conditions if it is to happen at all". Therefore, affect can predict students' writing performance. Lately, researchers have examined various affective

writing constructs such as apprehension, self-efficacy, anxiety, and outcome expectancy. Among these, perhaps the most salient is writing apprehension (Abdel Latif, 2015), a term proposed by Daly and Miller (1975) to describe "a situation and subject-specific individual difference concerned with a person's general tendencies to approach or avoid situations perceived to demand writing accompanied by some amount of evaluation" (Daly, 1978, p. 10). According to Guirdham (2017, p. 164), "it includes fear associated with writing situations, a tendency to avoid such situations, frustration, and low productivity while writing". Consequently, it can affect students academically and professionally. For example, apprehensive writers seldom engage in in-class or out-of-class activities and expect to fail in composing and turning in their assignments (Daly & Miller, 1975). They tend to choose college programs (Daly & Shamo, 1978) and occupations with minimal writing demands (Daly & Shamo, 1976) and show unwillingness to take advanced writing courses (Masny & Foxall, 1992).

Significantly, writing apprehension is inversely correlated with other affective factors like self-efficacy (Abdel Latif, 2015; Sanders-Reio et al., 2014) and self-esteem (Hassan, 2001) and negatively affects students' writing performance. Students with high-level apprehension (a) have more difficulty in getting ideas, grammar, and mechanics, (b) use less variety in sentence patterns, (c) include less information in each sentence, (d) spend less time composing, (e) write fewer drafts, and (f) produce lower quality writings than those with low-level apprehension (Abdel Latif, 2015; Reeves, 1997; Waer, 2021). Writing apprehension can be caused by lack of linguistic knowledge, low perceived language proficiency, poor writing achievement history, low writing self-efficacy, inadequate instruction and feedback, fear of evaluation, and time constraints (Abdel Latif, 2015; Al-khresheh et al., 2023; El Shimi, 2017; Lipsou, 2018). Accordingly, various empirical studies have been carried out to alleviate it, particularly using computer-mediated treatments such as web-based prewriting (Zaid, 2011) and employing word-processing programs (Morphy & Graham, 2012), WhatsApp-based tasks (Habibah et al., 2020), and wiki-mediated collaborative writing activities (Abd El-Wahab, 2022). Exploiting AWE, the intelligent essay assessor Autograder (Fisher, 2017), the Cambridge English Write&Improve software (Waer, 2021), Pigai (Sun & Fan, 2022), Grammarly (Dizon & Gold, 2023), Criterion (Haddadian, 2024; Sari & Han, 2024), and editGPT (Jubier et al., 2024) were utilized to ameliorate it.

Writing Self-Efficacy

As conceptualized within the social cognitive theory, self-efficacy refers to the "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997, p. 3). Likewise, Pajares and Miller (as cited in Mercer, 2011, p. 15) delineate it as "a context-specific assessment of competence to perform a specific task, a judgment of one's capabilities to execute specific behaviors in specific situations". In the context of writing, self-efficacy deals with a student's belief/confidence in his/her capacity to accomplish writing assignments. It is assumed to impact students' motivation, goal setting, effort, persistence, and problem solving during their writing activities. Students with high self-efficacy focus on setting goals and finding solutions to problematic areas whereas students with low self-efficacy often reflect on personal inadequacies, negative feedback, and lack of problem-solving abilities (Maddux, 2011; Mitchell et al., 2017; Richards & Schmidt, 2010).

Academically, Bandura (1997) describes four sources influencing self-efficacy formation: (a) mastery experiences, when attributing the product to students' own efforts, (b) vicarious experiences, when observing the accomplishments of their peers who are somehow comparable to them, thus making their successes or failures relevant, (c) emotional indicators, when demonstrating the effects of experiencing different physiological and emotional states, leading them to anticipate success or failure, and (d) verbal persuasions, from others regarding what they can or cannot do, which usually appear as feedback, encouragement, or praise from the lecturers. Moreover, Bruning et al. (2013) posit three components of writing self-efficacy: (a) ideation which means establishing and generating ideas, forming a strong basis for writing, (b) conventions which targets communicating those ideas through various linguistic skills (e.g. vocabulary, grammar, discourse), and (c) self-regulation which examines self-efficacy through affective and self-management control.

Significantly, writing self-efficacy is positively related to students' writing proficiency (Sun & Wang, 2020; Zabihi, 2018) and metacognitive strategy use (Golparvar & Khafi, 2021). Some studies investigated the mediational role of writing self-efficacy in the correlation between writing performance and other affective constructs (i.e., motivation, anxiety, and enjoyment). Self-efficacious students were highly motivated, experienced reduced anxiety and more enjoyment, and eventually did well in writing performance (Ardia et al., 2024, Vincent et al., 2023; Woodrow, 2011; Zhang & Guo, 2012). Effective instruction should therefore take cognizance of students' writing self-efficacy. Encouraging reflection practices significantly helped students to develop writing self-efficacy (Chung et al., 2021), especially in an online collaborative writing environment (Li, 2023; Rahimi & Fathi, 2021). Adopting AWE, the PEG Writing software (Wilson & Roscoe, 2020), Criterion (Sari & Han, 2024), and Grammarly (Su et al., 2024) were found to enhance it. Used as a writing tool, ChatGPT elevated it by generating written samples, providing immediate feedback, and creating a sense of accomplishment (Bouzar et al., 2024; Kang & Pyo, 2024). Moreover, utilizing generative AI platforms (e.g. Claude, Jasper, Shortly AI) promoted it in the context of digital storytelling creation (Pellas, 2023) and poetry writing tasks (McGuire et al., 2024).

The DWA Tool QuillBot

DWA tools use AI to analyze the input text in real time and suggest alternative phrasings conveying the same information to improve clarity, coherence, and originality. They also check and correct grammar, sentence structure, and other typographic errors. Thus, they can help students to self-assess their writing and review the writing of others by identifying and correcting the highlighted mistakes to get improved, making them focus more on organizing ideas and conveying the intended meaning (Odo, 2024). This reduces cognitive load, allowing students to devote less working memory to lower-order skills (e.g. grammar, spelling, punctuation, capitalization) and thus more mental energy and time to higher-order skills such as content development and organization (Gayed et al., 2022). This approach encourages self-directed learning and increases students' self-confidence and willingness to communicate more effectively in English (Odo, 2024). Nonetheless, DWA tools are not without their constraints. As Sienes and Sarsale (2024) note, they can encourage overreliance on AI systems for EFL learning and problem solving by prioritizing quick fixes over deeply understanding mistakes, thus their use must be controlled and regulated. Besides, their automated feedback may

sometimes deviate from academic writing standards, leading to potential inaccuracies that need further manual revision. In 2017, QuillBot (https://www.quillbot.com) was initially introduced as an AI paraphraser, but it has now included a grammar checker, a summarizer, and a translator. Its basic premise is still related to paraphrasing due to its empowering affordances. It allows users to choose from the different modes of paraphrasing, focusing on fluency or more academic/creative use of language. It enables users to control the number of word changes (synonym percentage), ensuring that not all items are altered arbitrarily to preserve the original meaning. It also permits users to shorten or expand the original input without changing the meaning, making it more concise or generating more ideas. In addition, it provides other analytical tools like comparing modes and character, word, and sentence counts (Adams & Chuah, 2023).

To date, limited empirical studies have examined the instructional effects of QuillBot on improving EFL writing performance and students' perceptions of the tool. Kurniati and Fithriani (2022) explored the perceptions of 20 Indonesian post-graduate English-majored students about QuillBot through a closed-ended survey and a semi-structured interview. The participants expressed positive opinions about the use of QuillBot in fostering their writing skills, especially vocabulary. They also reported that QuillBot provided them with beneficial rewrite options, enhanced their attitudes toward writing, and encouraged their language development. Hieu et al. (2022) studied the effect of a 10-week QuillBot-based program on enhancing 20 Vietnamese third-year English Language majors' EFL essay writing and their attitudes toward it. The post-test results indicated that QuillBot significantly improved the students' writing performance, particularly their lexical richness. Moreover, findings from a closed-ended questionnaire showed positive attitudes toward its use. Ha (2023) investigated the impact of an eight-week QuillBot treatment on 98 Vietnamese university sophomores' essay writing skills. The post-test results showed that the treatment group that used QuillBot in their home assignments significantly surpassed the control group in their essay writing abilities. Responding to a semi-structured interview, the students stated that QuillBot boosted their writing skills, particularly vocabulary, grammar, cohesion, and coherence and that they enjoyed experimenting with the application. Using a one-shot case study design, Yoandita and Hasnah (2024) examined the use of QuillBot among 20 EFL students who had completed their academic writing courses at an Indonesian university. After a 10-week program, the post-test results showed that QuillBot significantly enhanced the study groups' EFL academic writing performance in content, vocabulary, grammar, and mechanics. Regarding affective variables, one qualitative study reported the positive impact of QuillBot on writing self-efficacy among four university students through semi-structured interviews (Andriani et al., 2024), but none has tackled it on writing apprehension.

Theoretical Support for the QuillBot-Based Intervention

Constructivism suggests that "knowledge is actively constructed by learners and not passively received" from their teachers (Richards & Schmidt, 2010, p. 123). Students bring background knowledge from their previous writing experiences and progressively gain new knowledge through meaningful practices (Rob & Rob, 2018). Students need to search for and reflect on information about the given topic to actively construct their representations of understanding that draw on their prior knowledge (Ng, 2015). QuillBot rewrite options help students to

construct such understanding by delivering instant feedback and suggestions for improvement, encouraging them to critically evaluate their work and make modifications informed by their knowledge of language conventions (Odo, 2024). Related to this, the noticing hypothesis asserts that consciousness of linguistic features of the FL (input), at the level of noticing, triggers the processes responsible for integrating new linguistic forms into students' existing knowledge (intake) (Schmidt, 1990). QuillBot features provide students with plentiful opportunities to notice the dissonance between their written texts and the generated rephrases (Barrot, 2021). Likewise, Long's (1996) interaction hypothesis claims that receiving comprehensible input and interactional feedback during negotiations for meaning and form promotes EFL acquisition. These negotiations trigger cognitive processes such as focused attention when students attend to the feedback and attempt to incorporate it into their modified output. The interaction happens when students collaboratively review the QuillBot feedback and subsequently process, compare, and connect it with their existing knowledge (Barrot, 2021). This pertains to Vygotsky's (1978) sociocultural theory, previously mentioned, since students' social interactions provide a scaffold to learning within their zone of proximal development (ZPD) through the assistance of their peers and the QuillBot feedback.

Method

Design and Participants

This study employed the mixed-methods approach using one group of participants. Quantitatively, one test and two scales were administered before and after experimentation to measure the impact of utilizing QuillBot collaboratively on the study group's writing performance, apprehension, and self-efficacy. Qualitatively, students' written reflections were also collected to gain deeper and broader insights into their perceptions of the QuillBot-based intervention, thereby strengthening the credibility of the results. The participants, who were in the 21 to 22 age range, constituted 18 fourth-year students (two males and 16 females) in the English Language Department, Faculty of Archaeology and Languages, Matrouh University, during the second semester of the 2023-2024 academic year. They were L1 Arabic speakers with an intermediate level of English proficiency who had studied EFL for about 12 years before university enrolment. All participants were digitally literate and had successfully passed the Computer Skills course offered in the second year. For the study, the researcher made sure that all of them could access the Internet from their smart phones and laptops/tablets. Prior to the fourth year, they studied six university-level writing courses: Writing I, II, III, IV, V, and VI. They were aware of AI but had not used DWA tools before the experiment.

Instruments

Four instruments were developed. Firstly, the EFL writing performance test (WPT) was given as a pre-/post-test. It consisted of one question in which students were asked to write a five-paragraph argumentative essay (of at least 400 words) about one topic from two given topics (see Appendix A). Items for constructing this question were taken from Davis and Liss's *Effective Academic Writing 3: The Essay* (2006). To achieve the content validity of the WPT along with its scoring rubric, a jury of six Egyptian university professors of linguistics and applied linguistics (TEFL) assessed it with respect to clarity of its question, relevance to the objective it purported to measure, and suitability to the students' academic level. They revealed

that the WPT could be considered an accurate measure of EFL writing performance. Thus, a pilot study was executed on 14 fourth-year students- from outside the study sample- during the second semester of the 2022-2023 academic year, to determine test time and reliability. The assigned time required to answer the essay question was 50 minutes. It was estimated by calculating the average of the times spent by the students. The inter-rater reliability was computed using Pearson's correlation coefficient, which was 0.877, thus reflecting high test reliability. As two raters (the researcher and another EFL lecturer of the same teaching experience and qualifications) scored the students' writing performance in the pre- and post-tests, the mean was estimated. They used the developed rubric to measure students' EFL writing performance. This rubric comprised five dimensions namely content, organization, vocabulary, grammar, and mechanics. Each dimension was rated on a five-point scale (1 = *poor*, 2 = *below average*, 3 = *average*, 4 = *above average*, and 5 = *excellent*). Thus, the test scores ranged from 5 to 25.

Secondly, the EFL writing apprehension scale (WAS) was a 12-item measure (see Appendix B) adapted from Cornwell and McKay's (2000) Writing Apprehension Questionnaire which was developed to assess Japanese college students' writing apprehension and Abdel Latif's (2015) English Writing Apprehension Scale (EWAS) which was devised to assess Egyptian university students' writing apprehension. Thirdly, the 20-item EFL Writing Self-Efficacy Scale (WSES) (see Appendix C) was adapted from Bruning et al.'s (2013) Self-Efficacy for Writing Scale (SEWS) which aimed to assess middle and high school students' EFL writing self-efficacy beliefs, Abdel Latif's (2015) English Writing Self-Efficacy Scale (EWSS) which was designed to measure Egyptian university students' writing self-efficacy, and Sun and Wang's (2020) Questionnaire of English Writing Self-Efficacy (QEWSE) which was developed to assess Chinese college students' EFL writing self-efficacy. The participants were requested to specify their degree of agreement relating to writing apprehension and self-efficacy beliefs on a five-point scale (1 = *strongly disagree*, 2 = *disagree*, 3 = *neutral*, 4 = *agree*, and 5 = *strongly agree*). Thus, the scores ranged from 12 to 60 for writing apprehension and from 20 to 100 for writing self-efficacy. All items on the WAS and WSES were normally coded except for the items WA1, WA5, WA6, WA11, and WA12 which were reverse coded before summing the responses. To measure their internal reliability, the WAS and WSES were administered to the same students of the WPT pilot study where the calculated Cronbach's Alpha coefficients were 0.866 and 0.835 respectively, suggesting that the scales were highly reliable. Finally, the reflective writing questionnaire (see Appendix D) comprised five open-ended questions which asked the students to openly express their thoughts and reflect upon their experiences using QuillBot throughout the experiment. The inter-coder reliability was used where two coders (the same raters of the WPT) coded the data, compared their analyses, and resolved any differences. The appendices are readily available upon reasonable request to interested researchers.

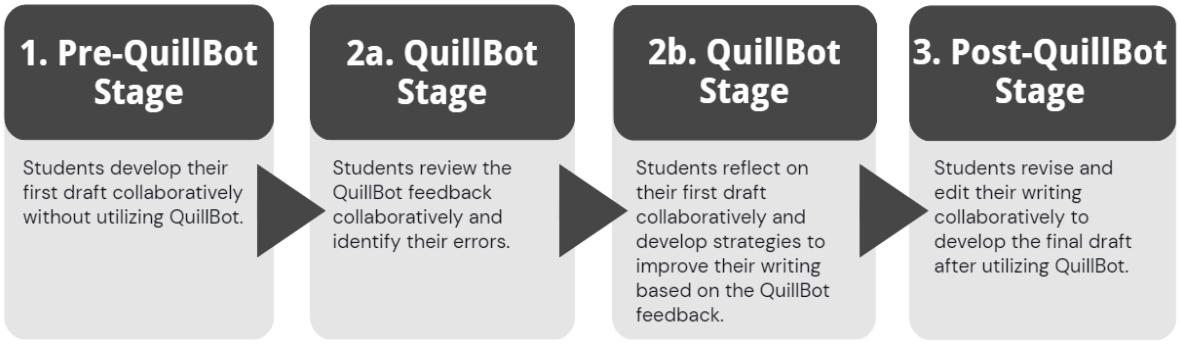
Experimental Procedures

The intervention of this study was implemented as part of the Essay II course. Before the experiment, the researcher pre-tested the study group using the WPT to determine the students' entry-level skills of EFL writing performance. After that, the WAS and WSES were distributed in two successive sessions, each of which lasted 15 minutes, to measure the students' writing

apprehension level and self-efficacy beliefs. Pre-testing was held on 18th February 2024. During the first week of the experiment, a two-hour orientation session was devoted to introducing QuillBot and showcasing its grammar checker, summarizer, and paraphrasing modes that could be used free of cost (i.e., Standard and Fluency). To facilitate this, a step-by-step tutorial video was watched and made available for reviewing purposes. This session also targeted training students on collaborative writing behaviors involving the different writing stages and using the EFL writing performance scoring rubric (see Appendix A) to evaluate their products. Then, they engaged in a QuillBot-based activity to try out the tool by collaboratively writing an argumentative essay on a given topic. During this time, the researcher circulated, facilitated the process, and answered students' questions regarding QuillBot. Earlier in the course, students had learnt about the components and structure of argumentative essays. Lastly, a WhatsApp chat group was established for the participants to share resources and drafts and to provide peer reviews. For Weeks 2-6, students were required to write a five-paragraph essay (of at least 400 words) on a given topic each week. Students in small groups initiated the process by brainstorming and gathering information from personal experiences, books, journals, and the Internet, then wrote the thesis statement for the introduction and took notes containing details and examples to support their position for the body paragraphs and the conclusion. They collaboratively organized their ideas and pooled their first drafts without using QuillBot. Then, they pasted these drafts to QuillBot and collaboratively reviewed the generated feedback, identified the errors, and developed strategies to correct them using its grammar checker, paraphrasing modes, and summarizing options. After that, they engaged in revising their writing and composing their final drafts based on what they had learnt from the QuillBot feedback. This three-stage process (see Figure 1) allowed students to monitor their progress on each week's two-hour in-class activities by comparing their pre-QuillBot versions with their post-QuillBot versions. The researcher circulated to make sure that all students were getting the chance to offer suggestions and make modifications without directly affecting their content and/or the trajectory of the AI-feedback. At the end of each session, two minutes were given to each group to present a different new linguistic feature learnt from the QuillBot feedback.

Figure 1

The Writing Procedures for Each QuillBot-Based Activity

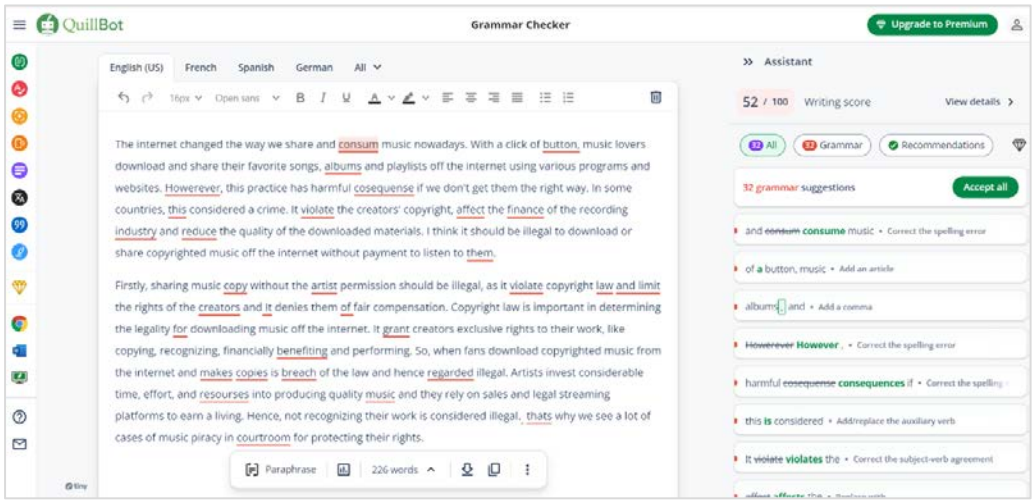


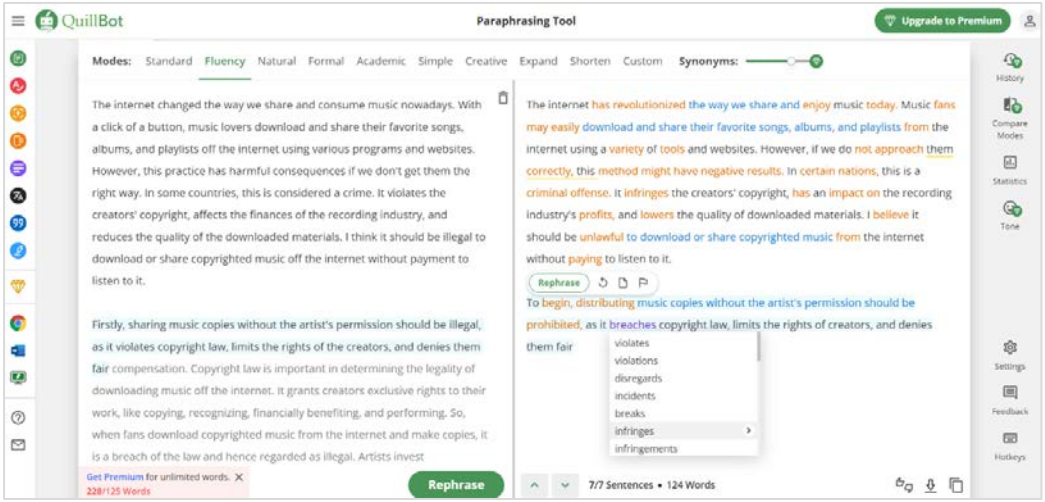
Moreover, the participants collaborated on several out-of-class QuillBot-based activities to compose five more argumentative essays as home assignments following the same procedures.

On the WhatsApp group, they were required to include two versions of their writing drafts (i.e., pre-QuillBot and post-QuillBot) and captured screenshots of their QuillBot results (see Figure 2 for some samples), providing tangible evidence of their progress in writing. This inclusion constituted a part of the students' assignment grade, encouraging them to incorporate QuillBot in their writing each week. Students were also asked to give feedback and make comments on their peers' merits, demerits, and areas of improvement.

Figure 2

Samples of Students' Work Using QuillBot





Finally, after six weeks, the researcher post-tested the students using the same instruments plus the reflective writing questionnaire on 31st March 2024. Due to the small sample size, the participants' scores on the pre- and post-administrations were statistically analyzed employing the nonparametric Wilcoxon Signed-Rank Test. It was used to compare the differences between the students' mean ranks on the pre- and post-administrations of the WPT, WAS, and WSES to investigate the effect of the QuillBot-based intervention. Besides, textual data from the students' reflective reports were analyzed using conventional content analysis to identify positive and negative themes related to QuillBot deployment.

Results

RQ_1: What are the effects of the QuillBot-based intervention on English Language majors' EFL writing performance, apprehension, and self-efficacy?

Table 1 displays the means, standard deviations, and *z*-scores for the differences between the students' mean ranks of the EFL writing performance, apprehension, and self-efficacy pre- and post-administrations. The means on the post-assessment of EFL writing performance and self-efficacy were higher than those on the pre-assessment, and the mean on the post-assessment of EFL writing apprehension was lower than that on the pre-assessment, thus denoting the positive effects of the QuillBot-based intervention. The standard deviations were generally small, signifying that the raw scores of the three variables were comparatively consistent before and after the experiment. Table 1 also shows that there existed statistically significant differences at the 0.01 level between the students' mean ranks on the EFL writing performance (z = -3.7236, $p < 0.01$), apprehension (z = -3.7236, $p < 0.01$), and self-efficacy (z = -3.7236, $p < 0.01$) pre- and post-administrations in favor of the post-administration. Thus, the study group made significant gains in EFL writing performance, apprehension, and self-efficacy on the post-administration. This might be ascribed to the implementation of the QuillBot-based intervention. In addition, the effect size was computed using Cohen's d to quantify the magnitude of the mean differences between the pre- and post-administrations for the three variables. Table 1 reveals that the means of both administrations in EFL writing performance (d = 1.354), apprehension (d = 4.424), and self-efficacy (d = 1.682) were very different, as suggested by the very large effect sizes. The QuillBot-based intervention might have contributed to such positive effects.

Table 1

The Z-Scores for the Differences between the Students' Mean Ranks of the EFL Writing Performance, Apprehension, and Self-Efficacy Pre- and Post-Administrations

Dimension/Construct	Group	*N*	*M*	*SD*	*Mean Rank*	*Sum of Ranks*	*z*	Sig.	Effect Size
1. Content	Pre.	18	3.08	0.624	-0.92	171	-3.7236	0.01	1.383
	Post.	18	4.03	0.737					Large
2. Organization	Pre.	18	2.92	0.647	-1.08	171	-3.7236	0.01	1.068
	Post.	18	3.58	0.600					Large
3. Vocabulary	Pre.	18	2.97	0.555	-1.03	171	-3.7236	0.01	1.236
	Post.	18	3.67	0.569					Large
4. Grammar	Pre.	18	2.86	0.614	-1.14	171	-3.7236	0.01	1.404
	Post.	18	3.69	0.572					Large
5. Mechanics	Pre.	18	3.03	0.528	-0.97	171	-3.7236	0.01	1.229
	Post.	18	3.72	0.599					Large
EFL Writing Performance (total)	Pre.	18	14.86	2.732	-5.14	171	-3.7236	0.01	1.354
	Post.	18	18.69	2.926					Large
EFL Writing Apprehension	Pre.	18	39.94	3.298	15.94	171	-3.7236	0.01	4.424
	Post.	18	26.56	2.727					Large
EFL Writing Self-Efficacy	Pre.	18	61.28	4.295	-12.72	171	-3.7236	0.01	1.682
	Post.	18	70.44	6.401					Large

RQ_2: What are the English Language majors' perceptions of the QuillBot-based intervention? The content analysis of the students' written reflections revealed eight positive themes as displayed in Table 2. All participants believed that utilizing QuillBot collaboratively helped them to develop their writing performance skills. Most students thought that the QuillBot-based intervention increased their writing self-efficacy (nearly by 78%) and reduced their writing apprehension (nearly by 67%). Slightly more than half of the respondents (55%) reported that the DWA tool presented a more enjoyable and stimulating writing practice alternative compared to regular methods, and half of them stated that QuillBot drew their attention to specific errors in their essay writing, making them more aware of their common mistakes. About 44% stated that QuillBot provided them with various empowering affordances, and approximately 39% found it easy to use and navigate. The last perceived benefit was the increased practice opportunities, on which five students commented.

Table 2

Positive Themes Regarding the QuillBot-Based Intervention

Theme	Number of Respondents (Percentage)	Example Quotations
Improved Writing Performance Skills	18 (100%)	*- Using QuillBot collaboratively was incredibly useful as it instantly detected grammar and punctuation errors and gave us different synonym suggestions. It also provided us with many rephrases containing varying sentence structure. Thus, it helped us in improving our grammar, mechanics, and vocabulary in ways that we could not have achieved on our own. QuillBot also helped us in correcting some connectors and better recognize the relationships between sentences and paragraphs.* *- Writing our drafts, reviewing the QuillBot feedback together, and discussing our weaknesses boosted our grammar, expanded our vocabulary and enhanced our content as QuillBot discovered various grammar mistakes and altered the mode/style of our writing to be more fluent and readable.* *- QuillBot was very beneficial while revising and searching for synonyms. In the beginning, I was a little skeptical about its use to improve my writing performance, but after a few sessions, I could see a decrease in the number of mistakes and a noticeable improvement in my writing performance skills.*
Increased Writing Self-Efficacy	14 (77.8%)	*- By performing collaborative tasks while using QuillBot corrections and suggestions, we noticed a rapid change in our witting quality. This raised our self-confidence and encouraged us to continue using this helpful tool to improve our writing skills and keep practicing beyond the classroom setting.* *- With collaborative writing and QuillBot, I felt more assured in my English writing capabilities than I did in the past. This confidence made me go about my writing tasks and track my progress each week, full of enthusiasm.* *- Prior to utilizing QuillBot, I was often unsure of what I was composing with respect to grammar and content. Utilizing QuillBot made me feel as if I had my own private tutor watching over my shoulder as I wrote. This made me less worried about my writing and more confident than ever before.*
Decreased Writing Apprehension	12 (66.7%)	*- Using QuillBot collaboratively reduced our level of writing apprehension because we felt that we no longer needed to worry about the correctness of our writing as we did before.*

		- I am not afraid of my writing being read or corrected by my colleagues or the teacher anymore. This situation was embarrassing to me before. *- Employing QuillBot with my colleagues created a comfortable learning environment to practice writing without being afraid of the final grade.*
Writing Enjoyment	10 (55.6%)	*- We enjoyed using QuillBot while working together to improve our first draft because of its user-friendly interface and immediate feedback. We were very satisfied with the final draft and the progress we achieved each week.* *- We were very happy to write essays collaboratively using QuillBot, especially when we compared our pre-QuillBot version with the post-QuillBot one. It made practicing writing more enjoyable than just doing the ordinary writing drills and assignments.* *- When using the paraphraser, we enjoyed seeing the highlighted changes and suggestions in two boxes and the immediate improvement in our drafts.*
Metalinguistic Awareness	9 (50%)	*- When QuillBot detected our mistakes and suggested changes to our writing drafts, we began to think deeply about and discuss what was inaccurate and how it was fixed to write our final draft.* *- Using QuillBot made us aware of our weaknesses and strengths and helped us to analyze and compare our version with the modified one. It helped us in making decisions to choose the best suggestions.* *- I never realized how often I make certain mistakes in grammar, word choice, and mechanics until I started using QuillBot. Seeing the QuillBot feedback helped me to pay attention to the usual mistakes I make in my writing and focus on developing strategies to improve it.*
Provision of Various Affordances	8 (44.4%)	*- Using QuillBot helped us to enhance our writing because it has many features: a grammar checker, a paraphraser, and a summarizer.* *- QuillBot has all the features I need in one website to improve my grammar, vocabulary, and content.* *- Instead of using multiple apps, I can make use of the various features that QuillBot offers to improve my essay writing.*
Ease of Use	7 (38.9 %)	*- We were able to use QuillBot easily and automatically to detect mistakes, speed up the writing process, and improve the essay quality.* *- It was easy to use. By just pasting the text, QuillBot worked quickly to check grammar and conventions. By just clicking "Rephrase" or "Summarize", QuillBot automatically rewrote and improved our written work.* *- We were able to revise our essays easily and quickly with one click.*
Increased Practice Opportunities	5 (27.8%)	*- Using QuillBot collaboratively inside and outside the classroom gave me more opportunities to practice writing without feeling self-conscious.* *- The use of QuillBot with my classmates offered me lots of opportunities to practice essay writing in a low-pressure environment.* *- Employing the QuillBot-based activities provided me with sufficient practice to enhance my essay writing skills.*

While negative comments were generally infrequent, four themes were obtained from the content analysis as perceived disadvantages of QuillBot (see Table 3). Specifically, the negative theme reported most often was related to the limitations of the free version of

QuillBot. Approximately 33% of the respondents stated that its free version had limited features, and the premium edition was somewhat expensive for them. About 17% reported that receiving too much feedback from QuillBot lowered their motivation and made them experience feedback fatigue. The third and fourth disadvantages were vague feedback and access problems, which were remarked on by only two of the students.

Table 3

Negative Themes Regarding the QuillBot-Based Intervention

Theme	Number of Respondents (Percentage)	Example Quotations
Limitations of Free Version	6 (33.3%)	*- The difficulty with QuillBot was that it requires payment to get important functions other than the ones offered in the free version.* *- Various paraphrasing modes are not present in the free version. We need to upgrade to the premium one to unlock these modes, which is rather pricy for us.* *- The free plan provided me with few services. I needed to try the "Academic" and "Expand" modes to make my writing better.*
Excessive Feedback	3 (16.7%)	*- At first, we felt drained after receiving too much feedback and suggestions from QuillBot that should be dealt with to improve the final draft.* *- Seeing a lot of mistakes and changes made us feel less-motivated at times.* *- It was sometimes tiresome for us because we made many mistakes, and our writing drafts needed various revisions.*
Vague Feedback	2 (11.1%)	*- Sometimes, we did not understand why QuillBot changed the words or phrases. So, we consulted the lecturer to provide us with more explanation.* *- We think that QuillBot made unclear suggestions a few times and we depended on our own judgment to rewrite the sentences.*
Access Problems	2 (11.1%)	*- We must have internet access to operate it. It cannot be used offline.* *- We cannot use QuillBot if we do not have an online access.*

Discussion

The Effects of the QuillBot-Based Intervention

Concerning the first question, the quantitative results indicated that the QuillBot-based intervention had significant positive effects on the participants' writing performance, apprehension, and self-efficacy. This might be attributed to two main reasons: QuillBot specific features and the process of implementing the QuillBot-based intervention. Regarding the first reason, students might have benefited from the accessible and visually appealing interface of QuillBot. Its user-friendly layout enabled students to effortlessly navigate and interact with the tool. It presented the original draft and the modified one in two adjacent windows to clearly compare versions. It also highlighted in different colors the modifications it made and provided various customizable modes of paraphrasing and summarizing. This enabled students to easily detect grammar and mechanics mistakes, find more synonym suggestions, choose between different writing styles, and notice various strategies of paraphrasing and summarizing. Moreover, students might have learnt from the QuillBot real-time and personalized feedback which allowed them to see instantaneous suggestions tailored to their specific writing needs. This individualized approach made students reflect on their areas of weaknesses as they reviewed the generated feedback and expend their efforts effectively. With respect to this, the

use of QuillBot is guided by Sweller et al.'s (2011) cognitive load theory which posits that students have limited cognitive capacities and that the extraneous cognitive load (also called split attention) should be reduced to facilitate learning. Because of the QuillBot easy-to-use and intuitive interface, students did not have to split their attention between the technical aspects of the tool and processing new information. This decreased their extraneous load and allowed them to focus entirely on the assigned activities (Ng, 2015). By providing automated feedback, QuillBot also lessened some of the cognitive load connected with the complex writing process and the fear of making mistakes, allowing students to approach writing with greater confidence, deploy less mental effort on lower-order issues such as grammatical error correction and word production, and allocate more time to higher-order writing activities such as revision and organization (Clarke et al., 2024; Gayed et al., 2022; Nawal, 2018). Drawing on Schmidt's (1990) noticing hypothesis, the utility of QuillBot could also be explained as its immediate feedback and highlighting features facilitated noticing. Employing QuillBot encouraged students to analyze and evaluate their first drafts and make conscious decisions to improve them, thereby promoting the development of their writing skills. From these factors, it could be indicated that QuillBot affordances which minimized the students' cognitive load and accelerated noticing led to their improved writing performance, which in turn, positively impacted their writing apprehension and self-efficacy as demonstrated by Chen et al. (2022) and Feldon et al. (2024) who claimed that easing the cognitive load positively influences writing apprehension and self-efficacy.

Interestingly, using QuillBot characteristics was beneficial in improving the students' overall writing performance skills. Concerning content, QuillBot provided students with various rephrasing suggestions, showing them several ways to effectively communicate their thoughts, thereby nurturing idea development and overcoming writing blocks. Regarding organization, QuillBot facilitated the logical progression of students' arguments by identifying inconsistencies, removing redundancies, reorganizing sentences and paragraphs, and enhancing coherence as their sentences seemed to flow naturally and smoothly, showing clearer connections. Relating to vocabulary, QuillBot recommended several synonyms and more sophisticated words and phrases that students might not have contemplated by themselves, thus increasing their lexical repertoire and allowing them to articulate their thoughts more accurately and engagingly. They replaced frequently used words and incorporated new vocabulary into their work to enhance its quality. As for grammar and mechanics, QuillBot detected and reformulated different types of errors, thereby helping students to minimize such errors in their written products and focus more on generating and organizing their content since DWA tools have the potential to reduce students' cognitive load. This is congruent with the results from studies by Hieu et al. (2022), Kurniati and Fithriani (2022), Ha (2023), and Yoandita and Hasnah (2024), who documented that utilizing QuillBot supports students' EFL writing performance and provides a useful medium for promoting it through its tailored feedback. Utilizing QuillBot also led to diminished writing apprehension and enhanced writing self-efficacy. Students' fear of writing and evaluation was decreased. Students' beliefs about their capacity to generate ideas, turn them into acceptable written forms, and successfully self-manage the writing process were boosted. This might be ascribed to the nature of QuillBot which provided students with an engaging and supportive learning environment where they meaningfully experimented with language without the fear of making mistakes. This agrees

with the findings of scholars who concluded that automated feedback significantly reduces writing apprehension (Dizon & Gold, 2023; Fisher, 2017; Haddadian, 2024; Jubier et al., 2024; Sari & Han, 2024; Sun & Fan, 2022; Waer, 2021) and promotes writing self-efficacy (Andriani et al., 2024; Bouzar et al., 2024; Kang & Pyo, 2024; Sari & Han, 2024; Su et al., 2024; Wilson & Roscoe, 2020).

Relating to the second reason, the significant gains in students' writing performance, apprehension, and self-efficacy might be linked with the various phases and procedures of the QuillBot-based intervention. That is, students might have profited from completing the assigned in-class and out-of-class QuillBot-based activities. Since frequent exposure to AI-generated feedback affords students multiple opportunities to promote their writing outcomes and positive emotions (Meyer et al., 2024), the repeated usage of QuillBot might have contributed to the positive results of this study. It provided students with sufficient practice and revision opportunities and timely feedback which may be lacking in the conventional classroom owing to the teachers' workload. Supported by Vygotsky's (1978) sociocultural theory and Long's (1996) interaction hypothesis, the collaborative component of the intervention might have enhanced students' writing skills and affective states as well. In the pre-QuillBot stage, students interacted with their partners and jointly constructed their first drafts. After that, they utilized QuillBot to check the language used. Finally, by deliberating about the AI-generated feedback and collaboratively deciding on modifications, students participated in meaningful language-centered negotiations and interactions to compose their final drafts, thus promoting their writing performance. Through this collaborative work, students did not only develop their writing abilities but also had several opportunities to observe and/or learn from their peers throughout the different stages of the writing process, therefore benefiting from each other's strategies and insights, making them less worried and more self-efficacious (Li, 2023; Odo, 2024; Rahimi & Fathi, 2021). Furthermore, students implemented a valuable reflection practice at the end of each in-class session where they presented newly learnt English features from the QuillBot feedback. Guided by constructivism and the noticing hypothesis, this assisted them in reinforcing such new features and probably introducing their colleagues to some new linguistic forms that might facilitate their EFL learning. Moreover, students evaluated their performance and that of other groups via the developed rubric and WhatsApp comment features. This aided them in addressing the merits, demerits, and potential areas for growth of their peers' products, thus boosting their motivation to enhance them. This agrees with the results of studies by Odo (2024) and Wiboolyasarin et al. (2024) who concluded that AI-feedback paired with collaborative writing supports students' EFL writing proficiency.

Students' Perceptions of the QuillBot-Based Intervention

Regarding the second question, the qualitative analysis revealed that the study group displayed largely favorable perceptions toward the suggested intervention. Specifically, the number of positive remarks was greater than that of negative ones. Most of the students reported that the QuillBot-based intervention was effective in enhancing their writing performance, reducing their writing apprehension, and fostering their writing self-efficacy. They also acknowledged it for making them more aware of the gaps in their linguistic abilities. They perceived it as an engaging and easy-to-use application that enabled them to focus on enhancing their writing

skills with the help of its instant feedback and their peers. They believed it was helpful in providing them with ample writing and revising opportunities. These results complement the quantitative findings and might help to explain why using QuillBot collaboratively yielded positive effects on the students' writing performance, apprehension, and self-efficacy. However, a few drawbacks of QuillBot were identified, especially regarding the limitations of its free version and some deficiencies in its feedback. Besides, some participants were initially skeptical about its effectiveness in developing their writing skills. This indicates that there might be a mismatch between what research suggests about QuillBot (i.e., the tool is useful in developing EFL writing skills) and how some students perceive it. Accordingly, when introducing QuillBot to students, it might be beneficial to inform them about its positive impacts on EFL writing while referring to pertinent literature. This might serve to increase students' acceptance of AI-based resources and tools. These results agree with the findings of studies by Hieu et al. (2022), Kurniati and Fithriani (2022), Ha (2023), and Andriani et al. (2024), who reported students' positive perceptions of QuillBot as a valuable DWA application for enhancing their EFL writing performance and self-efficacy despite some constraints.

Conclusion

The purposes of this study were twofold: (a) to examine the effects of a suggested QuillBot-based intervention on English Language majors' EFL writing performance, apprehension, and self-efficacy, and (b) to ascertain the students' attitudes toward its use. Four instruments were designed to gather information and address the formulated research questions. The findings revealed that the QuillBot-based intervention significantly improved the students' writing performance, reduced their writing apprehension, and raised their writing self-efficacy. Furthermore, the students' perceptions toward it were quite positive. Thus, the QuillBot-based intervention proved to have positive effects on the study group's EFL writing performance, apprehension, and self-efficacy. These results are significant as they demonstrate that using QuillBot with collaborative writing can effectively enhance students' writing competence and affect (i.e., apprehension and self-efficacy, two aspects that have been underexplored in the DWA literature). Consequently, the present study contributes to the advancement of writing research by equipping EFL university teachers, practitioners, and curriculum developers with an innovative intervention based on synergizing AI feedback and collaborative writing, that could be incorporated into the modern-day writing instruction.

Despite these findings, there are still certain limitations to the present study, which call for more future research. As the study used the one-group pretest-posttest design, not including a control group, which might have provided another standard for comparison, impedes the definitive attribution of positive results to the influence of the QuillBot-based intervention. Another methodological flaw was related to the small sample size which constituted the total number of students registered in the English Language Department. Therefore, the study should be replicated, and the results should be confirmed by studies with a control group and larger samples. Since the previous studies tackling QuillBot, including the present one, were conducted on university students majoring in English Language, other suggestions encompass expanding the scope of the present study to involve participants from different educational levels and fields of study that require writing proficiency. Besides, as some students expressed their frustration with the limited features of the free version of QuillBot, it would be worthwhile

to examine if the premium version of the DWA tool better produces positive changes in students' writing performance, apprehension, and self-efficacy compared to the free edition. Finally, future studies could consider investigating the effect of utilizing QuillBot on other language skills and aspects such as translation skills and learner autonomy.

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