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The Impact of Grammarly AI-powered Writing Tool on the EFL Students' Writing Proficiency and Autonomy

Fatemeh Takallou

Corresponding Author: Department of English Language, Faculty of Persian Literature and Foreign Languages, Payame Noor University, Tehran, Iran. f_takallou@pnu.ac.ir

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Abstract

The integration of technology into educational settings has gained significant attention, particularly in language learning, with a focus on professional users such as instructors and researchers. However, little has been done on how it can assist students' writing proficiency and autonomy. This study examines the effectiveness of an AI Writing Tool in improving the writing skills and autonomy of Iranian EFL learners in virtual education. This study examines the impact of Grammarly on the writing performance and autonomy of EFL learners using a quasi-experimental design. A cohort of 52 English translation students from Payame Noor University's virtual education program was selected using convenience sampling and stratified based on their Oxford Placement Test (OPT) results. The experimental group received a Grammarly-based intervention, and the control group followed conventional methods. After ten sessions, post-tests in writing and learner autonomy were administered, and data were analyzed using ANCOVA to control for pre-test scores. The findings revealed a significant improvement in the writing proficiency and autonomy of the experimental group compared to the control group, emphasizing the potential of AI tools in addressing the challenges of virtual education in the Iranian context. These results underscore the importance of integrating Grammarly into EFL curricula to foster writing competence and learner independence. By addressing the specific needs of Iranian EFL learners, this study bridges a critical gap in research. It provides practical implications for educators and policymakers in adopting AI-driven tools for language learning.

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Introduction

Studies over the past decade have provided important information on the effectiveness of written corrective feedback (WCF) (Truscott, 1996). WCF has a role to play in second language (L2) learning (Nassaji & Kartchava, 2021); hence, the question is not whether to provide WCF on writing, but rather how to do so effectively (Bitchener & Ferris, 2012). With technological advancements and the integration of language learning with technology, computer-assisted language learning (CALL) has emerged as a significant development in language learning. Several studies have significantly contributed to the development of automated written corrective feedback (AWCF), such as Grammarly, which provides personalized feedback on grammar, punctuation, clarity, and style, making it a powerful tool for enhancing writing skills with AI capabilities (Grammarly, 2009). Tools like Grammarly have become essential in language education. Recent research highlights the value of technology in creating interactive and adaptive learning environments (Hwang et al., 2023; Utami et al., 2023). Some research has revealed AWCF's contribution to learners' grammar and writing development (Barrot, 2021; Gain et al., 2019; Huang et al., 2020; John & Woll, 2020; Khoshnevisan, 2020).

Since writing is a cornerstone skill for students in English language translation, it bridges their academic training with the practical demands of translating specialized texts across diverse fields. The emphasis on basic and advanced writing skills aligns with scholarly perspectives, such as those of Hyland (2003) and Grabe and Kaplan (1996), which highlight writing as a complex, multi-dimensional process. Hyland (2003) defines writing as a complex process of arranging phrases and coherently structuring them to communicate ideas effectively. He emphasizes that writing involves the mechanical arrangement of words and the strategic choices that reflect the writer's intent, audience awareness, and context. Likewise, the writing process, with its distinct stages of concept identification, organization, transcription, revision, and evaluation (Collins & Parkhurst, 1996), develops communication skills and fosters cognitive and metacognitive abilities essential for autonomous learning. This connection between writing competency and learner autonomy suggests that writing reflects a student's independence and critical thinking (Pemberton & Nix, 2012). Namely, learner autonomy has been recognized as a cornerstone of effective language learning, emphasizing active engagement and self-directed approaches (Benson & Voller, 2014).

Since various factors contribute to challenges in attaining competence in written English, including vocabulary proficiency, grammatical understanding, accuracy and fluency, writing strategies, and interpretation difficulties (Cumming, 2001; Myles, 2002), there is a need to address these challenges and promoting learner autonomy are critical objectives for language instructors (Abdalkader, 2022). On the other hand, there is a significant increase in the use of AI-driven writing tools and the adoption of English language writing practices, reflecting the need for improved writing competencies among

EFL students (Ahmed, 2010). Given the increasing interest in AI-driven instructional technology for language learning, there is a lack of empirical research on the effective integration of AI-driven feedback systems into the Iranian EFL syllabus (Utami et al., 2023). Although there is a tendency to integrate AI tools into education, there is limited empirical research on the impact of these tools in the specific context of virtual education, e.g., Payame Noor University, for Iranian EFL translators. While studies have highlighted the effectiveness of AI-powered tools, such as Grammarly, in improving writing skills and fostering learner autonomy (Fitria, 2021; Gayed et al., 2022), most of this research has been conducted in Western or global contexts, where educational systems and levels of English proficiency differ significantly from those in Iran.

The Iranian educational system, characterized by teacher-centered practices and varying levels of technological accessibility (Ghorbani, 2009; Hosseini et al., 2022), may influence the efficacy and adoption of such tools. The English Language Translation Program at Payame Noor University is part of the English Language Department. While studying specialized courses, such as English language translation courses, students must translate various texts in the economic, political, and press fields during their studies. The skills required to study this field include effective listening, writing, reading, and speaking. Basic and advanced writing are among the essential skills required. Within EFL classrooms, AI technology has the potential to revolutionize traditional teaching responsibilities, such as providing feedback on students' written assignments without direct instructor intervention (Razack et al., 2021). Despite concerns about writing and autonomy, the beneficial impact of AI-powered tools on students' writing proficiency and autonomy remains questionable. Moreover, existing studies often focus on the general application of AI tools without examining their specific effects on students' autonomy and writing skills in virtual education settings.

Virtual education presents unique challenges, such as reduced face-to-face interaction and a reliance on self-regulated learning, which can magnify the importance of tools like Grammarly. However, the lack of context-specific research addressing how Iranian EFL learners interact with AI tools in virtual classrooms limits our understanding of their potential to address these challenges. As such, this research examines the benefits of utilizing Grammarly's AI Writing Tool within the specific context of EFL learners' writing abilities and autonomy. By examining the effect of Grammarly on writing competence and autonomy, this research can provide valuable insights into the effectiveness of these technologies in educational environments and lead the instructional system to student-centered practices. On the one hand, writing proficiency encompasses the mechanical aspects of writing, including the ability to organize thoughts coherently, use appropriate vocabulary, and maintain a logical flow. Namely, autonomy involves the learner's capacity to take responsibility for their learning and make independent decisions. A strong link exists between writing proficiency and autonomy, where improved writing skills often correlate with increased learner autonomy (Pemberton &

Nix, 2012). This research explores how Grammarly, as an AI-writing tool, influences writing proficiency and autonomy. The study hypothesized that enhanced writing skills can lead to greater autonomy and vice versa. The research questions and null hypotheses are as follows:

- Does Grammarly have a significant effect on the writing performance of EFL learners?
- Does Grammarly have a significant effect on the autonomy of EFL learners?
- H01: Grammarly does not have a significant effect on the writing performance of EFL learners.
- H02: Grammarly does not have a significant effect on the autonomy of EFL learners.

Literature review

The integration of technology into educational settings, particularly in language learning, has been a significant area of research interest in recent years. Various CALL methods, including technology for media, web-based education, computer-mediated interaction, and social network services, have become increasingly prevalent among foreign language learners and educators (Smith & Wang, 2013; Rosell-Aguilar, 2013). The emergence of Artificial Intelligence (AI) represents a significant advancement in computer-based language learning, potentially creating and implementing efficient learning systems (Wenger, 2014; Schulze & Heift, 2012). AI, in its broadest sense, refers to the study and application of creating intelligent machines (Schulze & Heift, 2012). AI technologies are valuable tools in language acquisition, functioning as resources for learners and instructors (Dodigovic, 2005; Schulze, 2008). Integrating AI into educational environments represents a significant conceptual shift that impacts language acquisition, enhances engagement, and showcases the flexibility of learning (Fitria, 2021). Several technologies, including ChatGPT, Grammarly, ProWritingAid, Wordtune, and others, facilitate the incorporation of AI in writing classes (Kangasharju et al., 2022; Gayed et al., 2022; Fitria, 2021).

Computer-based language instruction, particularly in EFL educational settings, is imperative for pupil advancement (Alharbi, 2018). AI-based automated assessment systems are prominent computer tools in this domain, effectively detecting and identifying defects in learners' writing (Gayed et al., 2022). Gayed et al. (2022) developed a novel online application called AI KAKU, which utilizes AI technology to aid EFL learners in addressing cognitive challenges related to producing written English materials. Similarly, Fitria (2021) researched Grammarly as an AI-powered writing assistance service, concluding that its use improved performance. Incorporating AI into educational environments marks a significant conceptual shift in language acquisition, enhancing learner engagement and providing flexible learning opportunities (Fitria, 2021). Tools like ChatGPT, Grammarly, ProWritingAid, and Wordtune exemplify this trend,

facilitating AI-driven learning experiences in writing classes (Kangasharju et al., 2022; Gayed et al., 2022; Fitria, 2021). These tools utilize AI to deliver personalized feedback, adaptive learning pathways, and real-time assistance, thereby transforming how students approach writing tasks. Studies over the past decade have provided important insights into the effectiveness of AWCF on various skills and self-directed writing improvements (Burkhard, 2022).

These scholars emphasize the importance of integrating cognitive, linguistic, and strategic abilities to achieve effective communication, an essential skill for aspiring translators who convey meaning across languages and contexts. According to Grabe and Kaplan (1996), the acquisition of writing skills is intricately linked to the development of other related capabilities, including cognitive skills, language proficiency, and reading comprehension. They argue that writing development is a multi-faceted process that depends on an integrated skill set beyond just writing. The writing process, with its distinct stages of concept identification, organization, transcription, revision, and evaluation (Collins & Parkhurst, 1996), serves not only as a means of communication but also as a reflection of the writer's cognitive and metacognitive skills. As students navigate these stages, they engage in decision-making and self-regulation, crucial components of autonomous learning.

In EFL educational settings, computer-based language instruction has become essential for fostering student progress (Alharbi, 2018). AI-based automated assessment systems play a pivotal role by accurately identifying and addressing learners' writing deficiencies (Gayed et al., 2022). Together, these advancements underscore the potential of AI to revolutionize language learning and enhance educational outcomes. Since the process of writing, a pedagogical approach emphasizes the various phases of the writing process, which involves exploring, developing, and revising written materials. Hence, using AI tools is crucial in enhancing the efficiency of the writing-learning process and improving students' skills (Kurniasih et al., 2020). The emergence of AI tools has transformed the writing process by providing personalized feedback, adaptive pathways, real-time assistance, and self-directed learning (Burkhard, 2022).

According to Sheninger & Murray (2017), "Student autonomy" refers to a student's ability to be responsible for the learning process. McHone (2020) defines autonomy as the ability to independently take responsibility for learning and make choices about one's behaviors. Tucker et al. (2017) describe individuals who engage in activities based on their desires, enjoyment, or personal preferences as acting autonomously. Autonomous learning involves students taking an active role in their education by choosing educational opportunities and defining educational objectives independently, with instructors playing a supportive role by facilitating and guiding the learning process (Lo, 2010). The development of students' autonomy as thinkers is facilitated by higher-level questioning techniques, active participation in dialogues, and the provision of suitable choices (Lo, 2010).

In a comprehensive study, Barrot (2021) integrated Grammarly into L2 writing classrooms to see the role of adaptive metalinguistic explanation, self-directed learning, and noticing in improving L2 learners' writing accuracy within the context of the AWE environment. Grammarly was regarded as a language learning tool that could be used as an alternative to form-focused instruction or an essential tool during the revising and editing phases of the writing process, regarding the efficacy of AWE tools in facilitating the development of writing accuracy. It empowered students to take control of their learning by deciding which corrections to accept and reject based on available resources. However, it was suggested that deciding whether to reject or accept the corrections may be appropriate for advanced learners. The above findings align with earlier reports on the critical role of self-regulation and self-directed learning in second language (L2) development (Parra & Calero, 2019).

Comparing non-assisted mobile writing with Grammarly, Dizon, and Gayed (2021) investigated how these variables influenced the lexical diversity, grammatical accuracy, fluency, and syntactic complexity of L2 students' writing. The results showed that grammatical errors decreased, whereas lexical variation increased significantly. While synchronous AWCF enhanced L2 students' writing substantially, neither writing fluency nor syntactic complexity improved. They concluded that integrating real-time AWCF and predictive text may lower the cognitive load of L2 students, contribute to writing accurate compositions, and increase the breadth or size of vocabulary knowledge. Despite indicating the tone of a composition, Grammarly can only mention the existence of a problem; however, it cannot detect where the error lies and correct the errors related to pragmatics. Drawing on this problem and the affordance of Grammarly, Winans (2021) also found that Grammarly can raise learners' confidence and autonomy when involved in writing pragmatically appropriate compositions.

The interplay between writing and self-directed learning, leading to autonomy, suggests that writing competency often mirrors students' autonomy and critical thinking (Pemberton & Nix, 2012). AWCFs align with traditional strategies for fostering autonomy and empowering learners to take greater control of their writing development, creating an integrated approach that adapts to individual needs and promotes self-directed improvement. As technology advances, the emphasis on autonomy has evolved to incorporate digital tools that support independent learning and learning management systems. Integrating technology into this framework has further enhanced the role of autonomy in the learning process. Recently, AI has emerged as a powerful ally for enhancing the writing process, providing personalized feedback, adaptive learning pathways, and real-time assistance that promote self-directed writing improvement (Burkhard, 2022). Similarly, drawing on a mixed-methods design, Pratama and Hastuti (2024) examined the effect of AI in teaching writing skills and investigated the students' perceptions of using AI in learning writing. Their results revealed that employing AI tools, i.e., Gencraft and ChatGPT, for language learning platforms is promising.

According to Constructivist Learning Theory, pioneered by Piaget (1972) and Vygotsky (1978), learners actively build their knowledge, piece by piece, through experiences and interactions. Students learn best when they engage with the material and receive immediate feedback. Grammarly fits perfectly into this picture by providing real-time corrections and suggestions, helping students learn from their mistakes as they write (Grammarly, 2009). This active engagement helps them understand and apply language rules more effectively. Likewise, Autonomous Learning Theory emphasizes the significance of students taking control of their learning journey. Initial guidance transitions into independence as learners set goals, select their methods, and evaluate their progress (Benson, 2001). Grammarly complements this autonomous learning approach by empowering students to independently identify and correct errors, enhancing their confidence and fostering self-directed learning. These theories emphasize the importance of active engagement and independence, which can be facilitated by tools like Grammarly in language education. This research's theoretical framework draws from various educational and linguistic theories, including Constructivist Learning Theory, Autonomous Learning Theory, and CALL.

Virtual education, as part of CALL, has become increasingly prevalent in Iran, particularly in the post-pandemic era, where online platforms have facilitated access to education for geographically dispersed learners (Rahimi & Fathi, 2021). This shift has highlighted opportunities and challenges unique to the Iranian educational environment. Cultural factors, such as the traditional teacher-centered approach predominant in Iranian classrooms, may affect how students perceive and interact with AI tools like Grammarly (Hosseini et al., 2022). For instance, Iranian students may initially be less inclined toward self-directed learning approaches, such as those promoted by tools, as autonomy is often less emphasized in their educational system (Ghorbani, 2009). As such, the context of this study, which involves virtual education for English translation students in Iran, plays a critical role in shaping the interpretation and generalizability of the current findings.

However, technical issues such as inconsistent internet connectivity and limited access to advanced technological tools in some regions of Iran could further complicate the integration of AI in virtual classrooms (Alavi & Tabar, 2020). Consequently, while Grammarly has demonstrated potential in enhancing writing performance and fostering autonomy in various studies, its application and outcomes in Iranian EFL settings require careful consideration of these contextual elements to ensure its optimal effectiveness and relevance. Additionally, varying levels of English language proficiency across the student population can significantly influence the efficacy of AI-powered tools. Students with limited proficiency might face challenges interpreting Grammarly's feedback, particularly when it involves advanced linguistic concepts or nuanced suggestions (Fitria, 2021). Furthermore, scholars have argued that AI methods have not noticeably improved the overall standard of students' scholarly articles across several criteria, citing problems

such as the need for enhanced accessibility of features and the continual improvement of features (Park, 2019).

Method

Design and Context

A quasi-experimental design was implemented for this investigation. When it is not feasible to randomly assign participants to treatment and control groups, researchers sometimes resort to quasi-experimental procedures (Farhady, 2009) that entail the development of a comparison group. Pre- and post-tests, as well as interventions, were also employed to verify the efficacy of the study's research variables in the experimental group.

Participants

Seventy-five participants were selected using the convenience sampling approach from the virtual education of Payame Noor University. The participants were undergraduates studying English Language Translation. These students took part in the advanced writing course. Subsequently, the Oxford Placement Test (OPT) was administered to ensure sample homogeneity. The final participants consisted of 52 students in two classes whose scores were one standard deviation lower and higher than the mean on homogeneity tests, indicating an intermediate level of performance. The participants were then divided into two groups: an experimental group and a control group, each comprising 26 learners.

Materials

This study employed five instruments: the Oxford Placement Test, writing pre-tests and post-tests, the ESL writing framework, the Learner Autonomy Questionnaire, and Grammarly.

Oxford Placement Test

Participants' proficiency was evaluated using the Oxford Placement Test, which comprises 60 multiple-choice items covering various subjects, including cloze tests, grammar, and vocabulary evaluations. The test's reliability was assessed using Cronbach's α, yielding a coefficient of 0.81, indicating commendable reliability.

Writing Pre-test and Post-test

Before the study, a pre-test was conducted to ensure all participants had comparable and consistent writing skills. Participants were instructed to produce an essay within 45 minutes, consisting of 150 to 200 words, on one of two preselected topics: "Compare and contrast traditional education and virtual education" or "Discuss the effects of digital games on teenagers' behavior." A post-test, identical to the pre-test, was conducted after

the intervention, and the results were compared. Two raters evaluated the writings using the ESL writing framework, with an inter-rater reliability coefficient of 0.86.

ESL Writing Framework

Based on Knoch and Elder's (2013) framework, the assessment criteria for ESL writing emphasize communicative effectiveness, linguistic range, coherence, and accuracy. The framework assesses essays through integrated categories that reflect language proficiency and practical communicative skills, aligned with modern language learning standards such as the CEFR (Common European Framework of Reference for Languages). This model includes levels such as Basic, Independent, and Proficient, focusing on the ability to express ideas clearly, use appropriate vocabulary, maintain coherence, and adhere to language norms.

Learner Autonomy Questionnaire

The Zhang and Li (2004) questionnaire was utilized to evaluate participants' levels of autonomy in learning both before and after the intervention. This questionnaire, specifically designed to assess learner autonomy, comprises 21 items that measure various aspects of self-directed learning behaviors, including goal-setting, decision-making, self-regulation, and the ability to evaluate one's progress. Each item is rated on a five-point Likert scale, ranging from "strongly disagree" (1) to "strongly agree" (5), allowing for nuanced responses that capture different degrees of learner autonomy. The questionnaire demonstrated strong internal consistency reliability, with a Cronbach's α of 0.91, indicating high reliability and precision in measuring the autonomy construct. This robust psychometric property ensures the validity of the results, making the instrument a reliable tool for evaluating changes in learner autonomy due to the intervention.

Grammarly

This study used Grammarly, an AI-powered writing tool established in 2009. With over 30 million users worldwide, Grammarly helps users correct errors in grammar, punctuation, clarity, engagement, spelling, and transmission. It is accessible as a freemium and premium model, working as an online writing platform for web browsers such as Chrome, Safari, Firefox, and Edge (Heift et al., 2021) and a "plug-in for Microsoft Word providing general feedback on features such as spellings, verb tenses, and word choice, with a paid service that enables users to adjust the feedback" (Frankenberg-Garcia et al., 2019, p. 24). Grammarly Premium can provide an automated proofreading system that identifies errors related to 250 grammar rules, including clarity-focused sentence rewrites, sample sentence rewrites, automatic rewriting of hard-to-read sentences, tone adjustments, plagiarism detection, word choice, formality level, fluency, and additional advanced suggestions (Barrot, 2020). One flagship feature of this AI-powered writing assistant is the provision of corrections along with their corresponding explanations.

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Procedure

A convenience sampling method was employed to select 75 participants from a larger pool of students. Out of these, 55 students were selected based on their performance on the OPT, ensuring that all participants had an intermediate level of English proficiency. These 55 students were then non-randomly assigned to either the experimental group or the control group, with each group consisting of 26 undergraduate students. This non-random assignment was made to ensure an equal number of participants in both groups, thereby facilitating a balanced comparison.

To ensure comparability of the experimental and control groups, both underwent pre-tests for writing and autonomy. The writing pre-test assessed participants' initial writing skills, while the autonomy pre-test measured their baseline levels of learning autonomy. These pre-tests were crucial in establishing a baseline from which to measure the intervention's impact. The control group received traditional pedagogical training in writing. This involved conventional teaching methods such as instructor-led lessons, textbook exercises, peer reviews, and manual feedback on writing assignments. The training sessions focused on improving various aspects of writing, including grammar, coherence, cohesion, vocabulary, and overall writing structure. These sessions were designed to mirror standard classroom practices for teaching writing skills without the integration of AI tools. They received detailed written feedback from the instructor on their submitted assignments.

The experimental group, on the other hand, utilized Grammarly, an AI-driven writing tool, for their writing assignments. Each student in the experimental group was given access to Grammarly and instructed on how to use its features effectively. Grammarly provided real-time feedback on grammar, punctuation, style, and clarity, allowing students to make immediate corrections and improvements to their writing. Grammarly was integrated into the writing assignments, and students were encouraged to rely on the tool to identify and rectify their errors, thus promoting a more autonomous learning process. They received automated, real-time feedback from Grammarly, supplemented occasionally by instructor feedback to address more nuanced aspects of writing.

The treatment phase for both groups spanned 10 sessions, each lasting 90 minutes. These sessions were conducted over several weeks, ensuring that students had ample time to engage with the material and the provided tools. In the initial 10 minutes, a brief review of the previous session's content and an introduction to the objectives of the current session were presented. In the next 70 minutes, during the main activity period, students worked on their writing assignments. For the control group, this involved traditional writing exercises and receiving feedback from the instructor. For the experimental group, this period was spent writing and revising their assignments using Grammarly. A final 10-minute summary was presented, followed by a question-and-answer session to address the students' immediate concerns and questions. Both groups were given similar writing tasks to ensure consistency in the type of assignments. Topics varied across genres,

including narrative, descriptive, expository, and argumentative essays, to comprehensively assess writing skills.

After the 10-session treatment phase, both groups underwent post-tests to evaluate their writing skills and autonomy levels. The writing post-test assessed improvements in grammar, coherence, cohesion, vocabulary, and overall writing quality. The autonomy post-test measured changes in students' ability to self-regulate, manage their learning process independently, and take responsibility for their learning outcomes.

Data analysis

The data collected from the pre-tests and post-tests were used to measure the effectiveness of the Grammarly tool compared to traditional pedagogical methods. Statistical analyses, including ANCOVA, were conducted to compare the performance of the two groups, taking into account their pre-test scores to control for initial differences. This analysis provided insights into the relative improvements in writing performance and learner autonomy resulting from the use of Grammarly. The OPT was administered to both groups to homogenize students' English language proficiency.

Results

The Independent Samples Test was run, and the results are displayed in Table 1. According to Table 1, the significance level is greater than 0.05, indicating that there is no significant difference between the experimental and control groups; therefore, they are homogeneous.

Table 1

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
OPT	Equal variances assumed	.068	.795	.456	50	.650	.84615	1.85574	-2.88122	4.57353
	Equal variances not assumed			.456	49.82	.650	.84615	1.85574	-2.88155	4.57385

Table 2 presents the descriptive statistics for the experimental and control groups' writing and autonomy post-test scores. The experimental group, which received the Grammarly AI-Writing Tool intervention, had a mean writing post-test score of 79.38 (SD = 11.07). In contrast, the control group, which underwent conventional educational techniques, had

a mean writing post-test score of 67.58 (SD = 14.22). The total mean writing post-test score for all participants was 73.48 (SD = 13.95). For autonomy post-test scores, the experimental group had a mean score of 74.19 (SD = 12.89), and the control group had a mean score of 62.88 (SD = 14.24). The total mean autonomy post-test score for all participants was 68.54 (SD = 14.61).

Table 2

Descriptive Statistics

	Group	Mean	Std. Deviation	N
Writing Post-test	Experimental	79.3846	11.06735	26
	Control	67.5769	14.21597	26
	Total	73.4808	13.95158	52
Autonomy Post-test	Experimental	74.1923	12.89037	26
	Control	62.8846	14.24451	26
	Total	68.5385	14.61192	52

Box's Test was employed in this study to verify that the covariance matrices for the experimental and control groups were equal for both writing and autonomy post-test scores. This verification is necessary because unequal covariance matrices could violate the assumptions of ANCOVA, potentially leading to inaccurate or biased results. The nonsignificant test result ($p > 0.05$) indicated that the assumption of equality of covariance matrices was met, validating the use of ANCOVA to compare the effects of the Grammarly intervention on the dependent variables.

Box's Test of Equality of Covariance Matrices (Table 3) indicated that the observed covariance matrices of the dependent variables were equal across groups (Box's M = 1.804, F (3, 450000) = .575, p = .631). This result supports the assumption of equality of covariance matrices, which is necessary for performing ANCOVA.

Table 3

Box's Test of Equality of Covariance Matrices

Box's M	1.804
F	.575
df1	3
df2	450000.000
Sig.	.631

	Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.
	a. Design: Intercept + prewriting + preautonomy + group

Levene's Test of Equality of Error Variances (Table 4) indicated that the error variances of the dependent variables were equal across groups for both writing post-test scores ($F(1, 50) = 1.198$, $p = .279$) and autonomy post-test scores ($F(1, 50) = 2.512$, $p = .119$). This supports the assumption of homogeneity of error variances.

Table 4

Levene's Test of Equality of Error Variances

	F	df1	Sig.
Writing Post-test	1.198	1	.279
Autonomy Post-test	2.512	1	.119
Tests the null hypothesis that the error variance of the dependent variable is equal across groups.			
a. Design: Intercept + prewriting + preautonomy + group			

The ANCOVA results (Table 5) showed that, after controlling for pre-test scores, there were significant group effects on both writing and autonomy post-test scores. For writing post-test scores, the group effect was significant ($F (1, 48) = 39.198$, $p < .001$, $\eta^2 = .450$), indicating that the experimental group scored significantly higher than the control group. Similarly, for autonomy post-test scores, the group effect was significant ($F (1, 48) = 50.187$, $p < .001$, $\eta^2 = .511$), indicating that the experimental group had significantly higher autonomy scores than the control group.

Table 5

Tests of Between-Subjects Effects

Source	Dependent Variable	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power[c]
Corrected Model	Writing Post-test	3	2688.959	69.389	.000	.813	1.000
	Autonomy Post-test	3	2878.085	61.272	.000	.793	1.000
Intercept	Writing Post-test	1	1171.307	30.226	.000	.386	1.000
	Autonomy Post-test	1	388.540	8.272	.006	.147	.805
prewriting	Writing Post-test	1	6236.257	160.927	.000	.770	1.000
	Autonomy Post-test	1	3.847	.082	.776	.002	.059
Pre-autonomy	Writing Post-test	1	38.788	1.001	.322	.020	.165

	Autonomy Post-test	1	6955.673	148.080	.000	.755	1.000
group	Writing Post-test	1	1519.013	39.198	.000	.450	1.000
	Autonomy Post-test	1	2357.396	50.187	.000	.511	1.000
Error	Writing Post-test	48	38.752				
	Autonomy Post-test	48	46.972				
Total	Writing Post-test	52					
	Autonomy Post-test	52					
Corrected	Writing Post-test	51					
Total	Autonomy Post-test	51					

Table 6 provides the estimated marginal means for the dependent variables adjusted for the covariates. For writing post-test scores, the adjusted mean for the experimental group was 78.92 (SE = 1.224), while the adjusted mean for the control group was 68.05 (SE = 1.224). For autonomy post-test scores, the adjusted mean for the experimental group was 75.31 (SE = 1.348), compared to 61.77 (SE = 1.348) for the control group.

Table 6

Estimated Marginal Means

				95% Confidence Interval	
Dependent Variable	Group	Mean	Std. Error	Lower Bound	Upper Bound
Writing Post-test	Experimental	78.915[a]	1.224	76.454	81.376
	Control	68.047[a]	1.224	65.585	70.508
Autonomy Post-test	Experimental	75.308[a]	1.348	72.598	78.018
	Control	61.769[a]	1.348	59.059	64.479

a. Covariates appearing in the model are evaluated at the following values: Writing Pre-test = 66.8846, Autonomy Pre-test = 61.2115.

The results of this study indicate that the Grammarly AI-Writing Tool significantly improved both the writing proficiency and autonomy levels of EFL learners compared to conventional educational techniques. After controlling for pre-test scores, the significant differences in post-test scores demonstrate the effectiveness of Grammarly in enhancing writing skills and promoting learner autonomy. These findings suggest that incorporating AI-writing tools, such as Grammarly, can benefit educational settings, particularly by improving writing outcomes and fostering student independence.

Discussion

The findings of this study illuminate the significant impact of Grammarly, an AI-driven writing tool, on EFL learners' writing performance and learner autonomy. The notable improvement in the experimental group's writing performance and autonomy levels

underscores the potential of AI tools like Grammarly to enhance language learning outcomes. This research has significant implications for educators and researchers. Integrating Grammarly into language education programs, particularly those focused on writing skills, can be highly beneficial. These results align with previous studies that highlight the benefits of AI-assisted writing tools in educational settings (Fitria, 2021; Gayed et al., 2022; Dizon & Gold, 2023; Dizon & Gayed, 2024; Pratama & Hastuti, 2024; Utami et al., 2024; Xiao, 2024; Wale & Kassahun, 2024; Hwang et al., 2024).

In line with the present study, Dizon and Gayed (2021) compared non-assisted mobile writing with Grammarly and found that Grammarly influenced the lexical diversity, grammatical accuracy, writing fluency, and syntactic complexity of L2 students' writing. Their results showed that grammatical errors decreased, whereas lexical variation increased significantly. They found that synchronous AWCF substantially enhanced the writing of L2 students, but neither writing fluency nor syntactic complexity improved significantly by the end of their study. They concluded that integrating real-time CF and predictive text may lower the cognitive load of L2 students, contribute to writing accurate compositions, and increase the breadth or size of vocabulary knowledge. Similarly, Pratama and Hastuti (2024) found the effectiveness of AI in teaching writing and the students' positive perspective accordingly. They suggested AI platforms, namely Gencraft and ChatGPT, can significantly improve writing skills.

The study's outcomes align with the broader body of research on the use of AI in education. Studies like those by Abdalkader (2022) and Nazari et al. (2021) have similarly found that AI tools can significantly improve language learning outcomes, particularly in writing proficiency. Abdalkader (2022) highlighted the positive effects of AI activities on EFL writing fluency, while Nazari et al. (2021) observed notable improvements in academic performance among non-native English-speaking postgraduate trainees. The substantial increase in the experimental group's writing post-test scores suggests that Grammarly provides effective feedback that helps students correct errors, improve grammar, and enhance overall writing quality. This aligns with the CALL theoretical framework, which emphasizes the role of technology in providing immediate, personalized feedback that facilitates learning. According to Beatty (2013) and Warschauer (1996), such interactive and adaptive learning environments make a significant contribution to language acquisition and proficiency.

Notwithstanding, Park's study (2019) raised concerns about the consistency and accuracy of AI-generated feedback compared to human evaluators. The current research suggests that the benefits of Grammarly outweigh these concerns, particularly in providing immediate and actionable feedback. However, this does not diminish the importance of human oversight to ensure nuanced and context-sensitive feedback that AI tools might miss. On the contrary, some discrepancies were noted; for instance, Hwang et al. (2024) identified that while AI tools improve mechanical aspects of writing, they may not fully address higher-order writing skills, such as critical thinking and

argumentation structure. While our findings demonstrated improved writing proficiency, further qualitative analysis could clarify whether these gains extend to more advanced writing competencies.

Recent studies provide additional insights for this study; for instance, Utami et al. (2024) explored the integration of AI tools in EFL classrooms and found that students with limited technological exposure initially faced challenges but gradually adapted to the tools, resulting in improved academic outcomes. This adaptation aligns with the findings, which show that participants demonstrated steady autonomy and improved writing proficiency after the intervention. Using narrative inquiry, Koltovskaia (2020) employed a multiple-case study to explore how two students engage with AWCF. In their exploratory study, Lazic et al. (2020) investigated students' impressions of Grammarly as a supplemental instructional tool for supporting writing from sources. The participants expressed positive perspectives about Grammarly and its usefulness in teaching writing. The participants found Grammarly to be a helpful tool that can identify weaknesses in their grammatical structures, word usage, style, and writing mechanics.

The significant rise in autonomy scores among the experimental group indicates that Grammarly not only aids in writing but also empowers students to take charge of their learning. This finding is consistent with Autonomous Learning Theory, which posits that learners become more effective when independently managing their learning process. Using Grammarly allowed students to identify and correct mistakes, enhancing their self-regulation and autonomous learning capabilities. Benson (2001) suggests that tools enabling such independence foster a more proactive and self-directed learning approach. Similarly, Winans (2021) indicated in his study that Grammarly raised learners' confidence and autonomy when they were involved in writing pragmatically appropriate compositions.

Conclusion

This study examined the effect of the Grammarly AI-powered writing tool on the writing proficiency and autonomy of Iranian EFL students. The findings demonstrated that Grammarly significantly enhanced writing skills and autonomy in the experimental group compared to the control group, confirming its efficacy in addressing key challenges in virtual education. These results align with existing research on AI tools in language learning, emphasizing Grammarly's role in providing immediate, actionable feedback that facilitates learning and promotes independence.

The implications of these findings extend beyond the context of EFL classrooms. By integrating AI tools like Grammarly into curricula, educators can bridge gaps in traditional instruction, foster self-regulated learning, and potentially apply these technologies to other disciplines that require written communication. Furthermore, these advancements underline the growing importance of AI in shaping personalized and adaptive learning environments, which can transform educational practices across various

fields. By integrating Grammarly into students' writing, this study provides valuable insights for educators and policymakers seeking to effectively integrate AI tools into EFL curricula.

Despite its strengths, the study faced limitations, namely, the quasi-experimental design and relatively small sample size, which may restrict the generalizability of the findings. The quasi-experimental design, although practical, does not offer the same level of control as a randomized controlled trial, which may introduce selection bias. Additionally, the study's short duration constrained observations of the long-term effects of Grammarly on writing proficiency and autonomy. However, it is essential to consider the context of this study, the virtual education of English translation students at Payame Noor University, which may influence the generalizability of the results. The educational environment and language proficiency levels might affect how students interact with AI tools like Grammarly compared to students in different contexts.

Future research could also explore the integration of Grammarly with other AI tools and digital resources to create a more comprehensive language-learning ecosystem. Investigating the combined effects of multiple AI-driven tools could provide a deeper understanding of how technology can be leveraged to improve language learning outcomes. Incorporating qualitative methods, such as interviews and focus groups, could provide richer insights into students' experiences with AI tools and their perceptions of autonomy and writing improvement. Moreover, longitudinal studies assessing sustained impacts and investigations into diverse educational settings are necessary.

Understanding learners' subjective experiences can also help educators tailor interventions more effectively. Policymakers and educators are encouraged to consider integrating AI tools into curricula while addressing infrastructural and accessibility challenges to maximize their potential. Given the specific context of this study, researchers can investigate how Grammarly and similar AI tools affect learners in various educational settings. This can help identify contextual factors that influence the effectiveness of AI-driven language learning tools. For example, examining the use of Grammarly in various educational systems can provide a broader understanding of its impact and adaptability.

Bio-data

First Author: collected data, designed, conducted the procedure, wrote the first draft, and revised the final manuscript.

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