https://doi.org/10.17323/jle.2025.17642

Boosting Punctuation Proficiency: The Power of an Interactive Chatbot for EFL Learners

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ABSTRACT

Background: While technology is becoming more integrated into education, little research has been done on the contribution that chatbots must play when it comes to helping EFL learners gain some language ability, like grammar. Most current research focuses on vocabulary or learning grammar and thus does not understand how interactive, computer-based technologies can help develop rule-based writing skills. This study fills this gap by identifying the degree to which a WhatsApp chatbot improves punctuation skills, thus gaining insight into the promise of chatbot-enhanced teaching for certain language subskills.

Purpose: To evaluate the effect of a WhatsApp-based chatbot on improving Omani EFL learners' knowledge of English punctuation marks.

Method: Sixty Omani EFL learners from Sohar University in Oman participated in this study, divided into a control and experimental group. Both groups obtained in-class training on punctuation marks. The experimental group received additional explanation and practice regarding punctuation marks using an interactive chatbot. The chatbot bot was developed for the experimental group to enable two-sided interactions with the students. All the tests were piloted to ensure reliability and validity before the data collection and the main study round. A pretest, followed by a posttest and a delayed posttest, was conducted to compare participants' performance on English punctuation marks.

Results: The experimental group's mean scores increased from 8.06 (pretest) to 26.66 (posttest) and 24.16 (delayed posttest), significantly exceeding those of the control group. Kruskal-Wallis tests revealed no prior differences ($p = 1.000$), but statistically significant improvements were observed in the experimental group at both the posttest and delayed posttest ($p < .001$; $\eta^2 > 0.73$), with large effect sizes. These results indicate the lasting impact of the chatbot on punctuation ability.

Conclusion: This study underscores the importance of integrating interactive technologies into language learning environments to foster learner engagement and independence. By prioritising learners' needs and preferences, instructors can develop more efficient, student-centred methods that promote enhanced language acquisition. The study's findings highlight the potential of cutting-edge tools, such as interactive chatbots, to enhance language acquisition and promote ongoing improvement.

KEYWORDS:

Interaction, WhatsApp bot, EFL, Punctuation

Citation: Al Ghaithi, A., & Behforouz, B. (2025). Boosting punctuation proficiency: The power of an interactive chatbot for EFL learners. *Journal of Language and Education, 11*(2), 20-34. https://doi.org/10.17323/jle.2025.17642

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Received: March 14, 2024
Accepted: June 10, 2025
Published: June 30, 2025

INTRODUCTION

The integration of artificial intelligence (AI) into education has become increasingly prevalent in recent years, offering novel ways to individualize instruction and enhance student engagement (Roos, 2018; Schmidt & Strasser, 2022). Defined as a field focused on developing methods for high-level reasoning based on low-level input features without the need for direct human intervention (Healey, 2020), AI is now being applied across various educational domains. Among the most widely adopted AI applications in education are chatbots (automated conversational agents that provide immediate, interactive feedback) (Okonk-

wo & Ade-Ibijola, 2021). These tools have demonstrated potential to foster learner autonomy, increase motivation, and enhance language acquisition outcomes, particularly in vocabulary development and communicative competence (Wei-Xun & Jia-Ying, 2024; Song & Xiong, 2023; Wei, 2023).

In the context of language education, chatbots have been utilised to facilitate learner–system interaction through both textual and spoken input (Kerly et al., 2006) and have proven effective in addressing students' diverse learning needs (Colace et al., 2018). Their adaptability enables personalised pacing, independent exploration, and sustained engagement, while their integration into virtual classrooms has been linked to improved feedback quality and increased learner involvement (Chou et al., 2021; Vázquez-Cano et al., 2021; Essel et al., 2022). The versatility of available chatbot platforms (from low-code solutions like Flow XO and Botsify to more advanced environments like DialogFlow) makes their adoption accessible to a broad range of users, regardless of technical background (Satam et al., 2020; Kumar, 2021).

Despite growing interest in AI-supported language learning, a notable gap remains in the use of such tools to support writing-related subskills, particularly punctuation. Punctuation serves not only as a system of standardised marks that enhances textual coherence (Jan, 2009), but also as a crucial discourse marker that facilitates the interpretation of meaning (Daffern & Mackenzie, 2015; Scull & Mackenzie, 2018). Its correct use is considered a key indicator of linguistic and communicative competence (Vázquez-Cano et al., 2018). Nevertheless, traditional approaches to teaching punctuation, such as rule memorization and sentence correction, often fail to foster a deep understanding of its communicative function (Fang & Wang, 2011; Macken-Horarik & Sandiford, 2016). Learners benefit more from experiential and meaning-based engagement with punctuation, rather than from mechanical drills (Scull & Mackenzie, 2018). Yet, providing timely and individualized feedback (a critical component of such instruction) can be logistically challenging in conventional classroom settings.

Given these challenges, chatbots have been proposed as promising tools for delivering individualized writing practice and immediate feedback outside the classroom (Shail, 2019; Subramaniam, 2019; Kurup et al., 2021). However, most existing chatbots are designed for general conversational use in the learner's first language (L1), and there remains a lack of readily available tools for second language (L2) learners targeting specific writing competencies, such as punctuation (Kwon et al., 2023). This oversight is particularly relevant in contexts where writing accuracy is essential for academic success in English as a Foreign Language (EFL) settings.

To address this gap, the present study examines the use of an interactive WhatsApp-based chatbot designed to support punctuation training among Omani English as a Foreign Language (EFL) learners. While prior research has recognized the educational potential of WhatsApp bots (Al Ghaithi et al., 2024; Behforouz & Al Ghaithi, 2024), their application for targeted subskill development (specifically in punctuation) has yet to be examined. This study contributes to the literature by evaluating the extent to which chatbot-supported instruction can enhance learners' punctuation proficiency, offering insights into how interactive digital tools may be strategically employed to improve a frequently neglected aspect of language learning.WhatsApp was chosen because it is widely used in Oman, especially among university students. This makes it a user-friendly, well-known, and cheap way to teach languages. Other systems, such Elbot or Kuki, are less common in the area and may be harder to use or integrate. The emphasis on punctuation as a subskill rectifies a recognised deficiency in EFL instruction, where punctuation is frequently undervalued despite its crucial role in maintaining clarity and coherence in writing (Crystal, 2012; Truss, 2003). Moreover, focusing on Omani EFL learners addresses a particular contextual requirement: prior research has primarily emphasised grammar and vocabulary, resulting in an inadequate analysis of punctuation within this field. The present study addresses this deficiency by utilising a frequently used communication tool, thereby providing a pragmatic and contextually relevant enhancement to conventional research methodologies. Accordingly, this research investigates the following question: To what extent can a WhatsApp Bot improve Omani EFL students' proficiency in using punctuation marks?

LITERATURE REVIEW

Benefits of Chatbots in Education

Chatbots have quickly emerged as revolutionary tools in educational environments, particularly in optimising and individualising the learning and teaching process. Chatbots can be practical tools for guiding teaching-learning processes by assessing student work, enhancing materials, and tailoring training schedules based on individual needs (Bii, 2013; Ghose & Barua, 2013), and they are associated with microlearning tasks that give learners more authority over the procedure of education instruction and allow them to choose the pace at which they complete the task. Using this educational technique, students can more easily create learning environments and experiences where they can practice, study, or engage within a limited timeframe (Bruck et al., 2012; Vázquez-Cano, 2012, 2014). Research has shown that utilizing chatbots or virtual agents can enhance students' academic achievement and motivation in learning environments (Liew et al., 2017). Kamita et al. (2019) coupled chatbots with online education and discovered that chatbots aided self-learning, boosted motivation, and reduced stress. These studies together demonstrate the pedagogical effectiveness of chatbots; nonetheless, they predominantly highlight general academic enhancements without assess-

ing the technology's performance in particular language subskills or diverse educational contexts.

The benefits of employing AI chatbots in English education, together with the essential pedagogical components, have been thoroughly examined in another study. A total of 28 prospective instructors specializing in English education were instructed to utilize Kuki chatbots for one week, after which they were required to provide an evaluation of their experiences. The qualitative data from surveys and interviews were subjected to thematic analysis, identifying six main themes: teacher perspectives, student perspectives, communication, linguistic factors, affective factors, and assessment. The comprehensive results indicate that preservice teachers recognize AI chatbots as valuable tools for facilitating teaching and learning, benefiting both educators and students. Applying learner data to chatbot technology requires a strategic approach to ensure optimal chat interactions. Additionally, the research found that chatbots have the potential to enhance the confidence and motivation of English as a Foreign Language (EFL) learners in speaking the English language (Yang, 2022). This qualitative dimension adds significant complexity to predominantly quantitative research, suggesting that the perceptions of both learners and instructors on the usefulness of chatbots are vital for assessing long-term adoption. Yang's research enhances our understanding of teacher cognition; however, it does not directly link perceptions to quantifiable classroom outcomes. This indicates a significant disparity between theoretical possibilities and practical realities in this area.

The integration of AI chatbot help with collaborative notetaking (CNT) has been examined for its effect on the acquisition of semantic knowledge in EFL learners. Chen (2024) employed a quasi-experimental design and included 60 students from the English language and literature program. It aimed to compare the group that received support from an AI chatbot (AI-CNT) with the group that received conventional support (CNT). The findings demonstrated that the AI-CNT group exhibited superior performance compared to the CNT group in terms of learning performance, achievement, self-efficacy, metacognition, and reduced learning anxiety. The study highlights the potential of utilizing AI chatbot interaction in conjunction with the CNT technique to enhance the EFL semantic learning experience. This approach offers tailored language practices that involve interaction and are enhanced with feedback and emotional support. Nonetheless, it remains unclear whether these advantages stem from the chatbot's linguistic support, emotional reinforcement, or feedback system and how these components may vary across different educational contexts. The studies together provide compelling evidence for the effectiveness of chatbots in EFL teaching, particularly in enhancing motivation, vocabulary, and speech proficiency. However, the existing work frequently overlooks longitudinal designs, cross-skill integration, and comparative evaluations with alternative digital tools. Moreover, several studies focus on emotional or perceptual outcomes while failing to effectively link them to language development benchmarks. This study aims to address these deficiencies by examining the immediate linguistic outcomes of chatbot-assisted learning, as well as the cognitive and affective variables that influence these outcomes, particularly within underrepresented English as a Foreign Language (EFL) populations. These findings confirm the significant educational potential of chatbots; however, a comprehensive analysis of their impact on specific language acquisition subskills, particularly speaking, listening, and spelling, is essential for elucidating their functional scope and pedagogical precision.

Chatbots and Langauge Learning Subskills

Speaking and listening skills, essential for communicative competency, have been positively impacted by chatbot-assisted learning. In a study using the LINE Chatbot messaging app to examine exercises for English conversations, one of the educational activities in which 73 students participated was a four-week English conversation exercise that included both speaking and listening components. Participants established the experimental and control groups. The two groups engaged in learning activities after school using LINE Chatbot. The experimental group signed up for competitive discussion with the LINE Chatbot, whereas the control group signed up for unrivaled chat exercises. After school, while the experimental group used the LINE Chatbot to engage in competitive discussion activities, the control group did the same activities without assistance. According to the results, the LINE Chatbot enhanced each group's pupils' speaking and listening abilities (Chien et al., 2022). The results demonstrate that the level of chatbot interaction, specifically if it is competitive and dynamic, is central to improving vocal language abilities. This study did not examine the long-term retention of improvements or the impact of learner characteristics, such as anxiety levels and past exposure, on the outcomes. This distinction warrants further examination regarding how the integration of chatbots may affect specific cognitive and affective aspects of language acquisition.

The integration of voice chatbots with AI into language education has shown promise in increasing the proficiency of Vietnamese undergraduate students in speaking English through innovative and interactive means of developing fluency and communication skills. Duong and Suppasetseree (2024) conducted a quasi-experimental study involving 30 Vietnamese undergraduate students over an eight-week period. The participants engaged in English-speaking exercises with an AI voice chatbot over two weekly class sessions. They also took a speaking exam before and after the experiment, answered a questionnaire, and participated in a semi-structured interview. The findings indicated a notable improvement in students' English-speaking proficiency after using the AI voice chatbot, characterised by an enhanced use of hedging phrases, grammatical structures, and vocabulary.

The study proposes the incorporation of AI voice chatbots in teaching and learning activities to improve the speaking abilities of Vietnamese EFL undergraduate students. Furthermore, there is no consensus in current research about the emotional aspects that most consistently benefit from chatbot use, particularly across various cultures and levels of competency.

Supplementary research supports the efficacy of chatbots in enhancing receptive and productive abilities over extended instructional periods. In another study, Kim (2018) assessed the impact of chatbots on the listening and reading comprehension of English among 46 college students. Participants were randomly distributed between the experimental and control groups. For 16 weeks, members of the control group did not communicate with Elbot, whereas members of the experimental group conversed with the chatbot. Pretests and posttests were administered to measure the effectiveness of the treatment. The findings revealed that reading and listening comprehension increased significantly for both groups. In the post-listening assessment, however, the improvements in the experimental group were more noticeable. Furthermore, after being encouraged to interact with the chatbot, the experimental group showed improvement in listening comprehension, progressing from the intermediate to the advanced stage. The longitudinal gains have encouraged more studies into utilizing advanced AI technologies in speech learning, particularly those with voice recognition and natural language generation capabilities. Nonetheless, the study did not investigate whether learners employed different strategies while interacting with chatbots compared to traditional training, nor did it identify which chatbot features, such as personalization, adaptivity, or repetition, were more impactful.

Using chatbots in English learning settings has shown encouraging outcomes, especially in fundamental language competencies such as spelling. In a study aimed at developing an interactive chatbot to facilitate spelling improvement and gather students' perspectives on using chatbots in the language learning process, 60 Omani English as a Foreign Language (EFL) students were evenly divided into two groups: a control group and an experimental group. The results revealed that using interactive chatbots in an educational setting enhanced spelling proficiency among participants in the experimental group (Al Ghaithi et al., 2025). These findings demonstrate the key advantage of chatbot interventions: measurable improvements in academic achievement. This study emphasizes cognitive and affective benefits while presenting challenges related to scalability, long-term effects, and relevance to more complex linguistic domains, such as discourse-level speaking. Moreover, the absence of comparative data with other digital solutions leads to a methodological shortcoming. Chatbot-enhanced instruction has proven effective for fundamental receptive and productive language skills; however, its impact on writing subcomponents such as punctuation remains underexplored, warranting more rigorous empirical investigation and targeted instructional innovation.

Technology and Punctuation

Experimental research has examined the impact of digital aids on learners' punctuation proficiency in academic writing. Ivanova et al. (2022) attempted to measure the effect of digital support on learners' appreciation and mastery of punctuation in academic writing, investigating this with 42 students. Standard face-to-face practices based on textbooks were implemented in the control group, whereas the experimental group underwent training using digital resources and a simplified textbook. Three final examinations served as a gauge of punctuation knowledge and proficiency. The findings showed that learning academic writing from standard textbooks alone was insufficient for improving punctuation. Digital assistance for teaching punctuation had considerable pedagogical potential. In the final assessments, the experimental group outperformed the control group. As a result, digital assistance should be a key component of academic writing instruction and included in training curricula. The study primarily focused on the number of punctuation marks, while additional studies have explored the types and frequencies of punctuation marks. This research highlighted the frequency of punctuation used, suggesting future studies analyze both the frequency and types of marks used, indicating a need for further scrutiny in future research. This study yields substantial quantitative data; nonetheless, it needs to examine how learners cognitively process punctuation usage using digital tools or whether these tools augment metalinguistic awareness. A cross-analysis of learners' proficiency levels and writing genres might yield more targeted pedagogical insights.

Interactive multimedia systems have demonstrated significant efficacy in teaching learners with disabilities about punctuation at various educational levels. To assist middle and high school students with various learning difficulties in applying punctuation techniques, a multimedia software tool was developed. This approach aims to determine whether a multimedia tool is effective in enhancing punctuation instruction for students who experience academic difficulties. Every student at every school level was randomly allocated to the experimental or control group. According to the results, experimental pupils at all school levels outperformed the control group, scoring noticeably better on the punctuation usage exam. Furthermore, the experimental students used less erroneous punctuation compared to the controls in the two educational groups. Additionally, the experimental students used the skills in a written test in which they composed original statements. Therefore, this study demonstrates that when taught using interactive multimedia, individuals can acquire punctuation procedures with high competence and apply their skills to sentence modification, as well as phrase-building problems. However, boundaries remain, particularly on the program's effects

on students' independent writing after instruction, highlighting the need for future research focused on long-term retention and transferability (Schumaker et al., 2019). This study provides significant evidence for the effectiveness of multimedia-assisted learning in students with impairments; however, it does not examine whether mainstream learners can achieve analogous advantages. Moreover, there is a lack of examination into whether the multimedia tool promotes strategic self-regulation or learner reflection, both of which are essential for sustainable writing improvement.

The efficacy of WhatsApp Messenger has been tested in various educational settings to improve students' punctuation marks knowledge. In one such study, Abdul Fattah (2015) examined an experimental group comprising undergraduate students who received instructional materials through WhatsApp to determine whether it could enhance the student's use of punctuation marks. The results revealed that students' proper use of punctuation marks significantly increased in the presence of WhatsApp Messenger. The study scope was limited to one skill area, implying the need to extend mobile treatments to encompass more facets of writing development components.

Self-editing programs have helped analyze the role of smartphone usage in developing EFL learners' self-editing skills. Eighteen Saudi Arabian students were assigned White Smoke, a self-editing application, to evaluate how technology could assist them in enhancing their writing skills. In week three, the learners were instructed to analyse and correct punctuation mark mistakes. The results revealed significant progress in the experimental group's ability to distinguish and correct punctuation-related errors within their learning context. Notwithstanding these advancements, the researchers acknowledged the limitations of their scope and sample size, advocating for more comprehensive investigations into the effects of mobile learning on various linguistic characteristics (Al-Wasy & Mahdi, 2016). This intervention's structured progression offers valuable insights into phased editing growth; however, the study overlooks the consideration of student viewpoints on the editing process and the advancement of their metacognitive editing strategies. These elements necessitate additional examination to understand not just the alterations that occur but also the underlying mechanisms and rationale behind them.

It has also become a source of interest in developing a new educational tool for teaching punctuation marks to university students using chatbots. The development of one to support Spanish university students in learning punctuation is a testament to the potential of AI-driven education in higher learning. In this case, the control group received instructions via the traditional method of writing exercises on paper, while the experimental group followed the instructions through a chatbot. The results revealed that students who used chatbots to interact with the materials performed more significantly than their counterparts in the control group. The chatbot provided a means for interacting with course materials, providing instant feedback and tailored responses that increased interaction and comprehension. This study suggests that chatbots may offer focused microinstruction in writing mechanics, indicating a need for further research into the application of chatbots in comprehensive writing instruction. As technology continues to develop, ongoing research will be necessary to assess its long-term effects and potential applications in other learning environments (Vázquez-Cano et al., 2021). This study highlights the potential of chatbot-assisted writing education; however, it does not compare it with human-facilitated formative feedback or examine the impact of chatbot characteristics, such as adaptivity and feedback type, on learning outcomes. These factors remain unexamined and are essential for the advancement of pedagogically sound AI systems.

AI-assisted training has demonstrated significant potential in several language abilities, including speaking, listening, reading, and spelling, yet punctuation remains a remarkably underexplored domain in EFL chatbot-based learning. Current research either focuses on general writing improvement or uses digital techniques unrelated to chatbot technology. There is a notable deficiency of focused studies on mobile-based chatbot instruction concerning punctuation, particularly in the context of WhatsApp, a widely accessible and familiar platform for learners in many English as a Foreign Language (EFL) environments. This project fills the gap by developing and utilising a WhatsApp-based chatbot that provides targeted microinstruction on punctuation. This study evaluates measurable language enhancements, offering a comprehensive understanding of chatbot efficacy in a sometimes overlooked facet of writing instruction.

METHOD

Participants

To collect the required data, 60 Omani students of English as a Foreign Language (EFL) were randomly selected as the study population. These students studied English in the General Foundation Program (GFP), a preparatory program that allows students to move to higher education studies. The participants' ages ranged from 18 to 19 years old. The students, who were a combination of both genders, were native Arabic speakers, and their English proficiency level was intermediate, as determined by the institution's placement test.

Research Instruments

English Punctuation Tests

The researcher created an English punctuation pretest, posttest, and delayed posttest to track participants' per-

formance before and after implementing the WhatsApp Bot, aiming to determine its effectiveness in helping Omani students use English punctuation marks correctly. Each test consisted of three sections: Section 1, which included 10 questions for correcting incorrect punctuation marks within sentences. In Section 2, another 10 multiple-choice questions were related to selecting correct punctuation marks, and Section 3 included 10 questions on True/False statements based on the punctuation marks used within the statements. The logic behind using these types of questions was that learners' regular exams and quizzes within the semester were all in the same format as in this study; therefore, students were familiar with the format of the questions. The pretest is provided in as an example (Appendix 1).

To ensure the reliability of the punctuation mark tests, a pilot study was conducted with 20 Omani intermediate English as a Foreign Language (EFL) students within the same institution. Two Omani PhD holders in Applied Linguistics were selected to review and refine the questions to validate those of the three tests. Table 1 shows the reliability results for the pretest, posttest, and delayed posttest. As can be seen, the tests had high-reliability indices of 0.860, 0.780, and 0.885, respectively.

Table 1

The Reliability of all Sets of the Tests

Tests	Cronbach's Alpha	N of Items
Pretest	.860	30
Posttest	.780	30
Delayed posttest	.885	30

Whatsapp Bot

The WhatsApp bot employed a decision-tree algorithm to determine the appropriate punctuation exercises, taking into account the student's prior responses and development. For example, if a learner provided a valid answer, the bot would present increasingly intricate exercises. In contrast, if errors were identified, the bot provided fewer complex exercises to strengthen understanding. The bot promptly delivered feedback in various formats: for questions with True or False options, it verified the correctness of the student's selection, and for exercises involving sentence correction, it supplied the appropriate punctuation when mistakes were made. The rapid feedback approach enabled pupils to learn from their errors promptly.

The developer pre-programmed and meticulously examined the responses to guarantee that the bot's input was high quality and accurate. The bot's database provided accurate responses for all questions, ensuring that students received dependable and pedagogically effective feedback. The bot's stability was further enhanced through regular monitoring and adjustments based on user interactions.

Punctuation Marks

The WhatsApp bot was developed using Python programming and linked to a nearby mobile device, facilitating smooth and uninterrupted interaction between the students and the bot. This configuration enabled students to engage with the bot via their WhatsApp program, providing them with the convenience of receiving and responding to punctuation exercises. The bot can send various questions, respond instantly, and distinguish between accurate and inaccurate answers, providing an interactive and engaging learning experience.

Although there are various punctuation marks in English, the primary focus of this study was on the full stop, apostrophe, comma, parenthesis, and question mark as the targets of the current study, which aimed to interact with the experimental group through the WhatsApp bot. The reason for selecting these types of punctuation marks was their commonalities among the writing papers of students, as determined through a detailed evaluation of their writing tasks within regular training. To elicit accurate details on the punctuation marks, a book by Noah Lukeman (2007) called A Dash of Style: The Art and Mastery of Punctuation was selected as the primary source of providing information.

Three different types of questions were developed for each English punctuation mark (True or False, multiple-choice, and sentence correction by writing the correct punctuation mark in six questions for each punctuation mark). These test formats were regularly used in the exams and continuous assessments of learners; therefore, there was no need for extra training or explanation on how to select the correct responses.

Procedures

This research was conducted in the fall semester of 2023 at Sohar University in the North Al Batinah region. Initially, learners were informed that their participation was voluntary and would not affect their future assessments. A pretest was conducted before implementing the treatment to ensure the homogeneity of the participants' knowledge of punctuation marks. Both groups were provided in-person instruction during their lessons to maintain a uniform teaching environment. Nevertheless, the experimental group employed the WhatsApp bot as a mediator, with the teacher utilizing the bot's interactive capabilities to send supplementary materials and exercises. This facilitated supplementary practice and consolidation beyond the designated classroom time. The researcher guided the experimental group on troubleshooting procedures and conducted a

training session to ensure comprehensive comprehension of the process among all students. The treatment process lasted for three weeks. Two sessions were specified each week to teach and practice the punctuation marks.

The questions and exercises were shared through the interactive chatbot for the experimental group. In True or False questions, students were given sentences with incorrect punctuation marks and had to decide whether the sentences were punctuated correctly or incorrectly by selecting True or False. In the second format, learners were given sentences with punctuation problems. The sentences must be rewritten with proper punctuation. Finally, students were given statements and sentences to be completed with the best option between the two others. In all these techniques, the bot provided immediate feedback to students on whether their answer was correct or incorrect.

It was possible to practice the questions indefinitely using WhatsApp Bot. In addition to demonstrating the use of the WhatsApp bot to practice English punctuation, the researcher advised the experimental group on what to do in the case of issues. Four questions were created as a training exercise for the colon and slash, among other punctuation marks, and the researcher held a training session to ensure that every student understood the process well.

For learners to learn from their mistakes, the bot informed them if their responses were correct or incorrect. Additionally, if the students' responses were inaccurate, the bot corrected them by providing the learners with the correct ones, helping them immediately recognize their mistakes. In contrast, when the instructions over some punctuation marks ended in the control group, similar types of exercises, including true/false, sentence correction, and multiple-choice, were administered using paper-based materials. To provide feedback to this group, the teacher identified errors in the students' assignments and offered general feedback to the class as a whole. Unlike using a chatbot, which provided personalised automated feedback, the control group received no individualised feedback. Immediately after the last week of treatment, the researchers conducted a posttest for both groups. Moreover, three weeks later, a delayed posttest was conducted.

RESULTS

This section presents the procedures and findings of the data analysis, including the assessment of normality, and systematically addresses the research questions using appropriate and interpretive methods. The primary research question of this study aims to investigate the effect of using an interactive chatbot on learners' proficiency in using English punctuation marks. Therefore, the following statistical procedures and tests were conducted comprehensively:

Measuring the Normality of Data in all the Tests

Initially, conducting a test of normality was necessary to select the appropriate parametric or nonparametric test for analyzing the data from punctuation tests in depth. Therefore, a Kolmogorov-Smirnov test was done, and the results are presented in Table 2.

Table 2

The Results of the Kolmogorov-Smirnov Test of Normality for all the Tests in two Groups

	Statistic	df	Sig.
Control pre	.136	30	.164
Control post	.166	30	.034
Control delayed	.121	30	.200
Experiment pre	.184	30	.011
Experiment post	.151	30	.080
Experiment delayed	.184	30	.011

Table 2 shows that the control pretest and delayed posttest data do not substantially deviate from a normal distribution (p-values 0.164 and 0.200, respectively), indicating that they conform to a normal distribution. However, the control posttest, experimental pretest, and experimental delayed posttest data show substantial deviations from normality, with p-values of 0.034, 0.011, and 0.011, respectively. The experimental posttest data, with a p-value of 0.080, is on the threshold and may not exhibit a substantial departure from normality. These findings suggest that nonparametric tests may be suitable for comparing the groups across all tests.

Performance of Control Group in Punctuation Tests

To monitor the performance of students in the control group based on the punctuation tests, a Wilcoxon test was performed, and the results are presented in Table 3.

As shown in Table 3, the statistical tests comparing different test times indicate significant variations in scores throughout each testing period. The comparisons between posttest and pretest ($Z = -4.789$, $p = 0.000$), delayed posttest and pretest ($Z = -4.237$, $p = 0.000$), and delayed posttest and posttest ($Z = -4.800$, $p = 0.000$) all demonstrate p-values below 0.05, showing statistically significant enhancements. The results indicate that the intervention led to notable improvements in performance from the first assessment to the final assessment, and these enhancements were sustained throughout the follow-up assessment. Additionally, extra progress was observed between the posttest and the delayed posttest. The effect size of all sets was measured accordingly to gain more detailed information and determine the exact differences and significance. The results are presented in Table 4.

Table 4, based on the effect sizes for the various test times, reveals significant disparities in performance. The pretest yielded a Cohen's d value of 2.158, indicating a substantial effect size. The 95% confidence interval for this effect size is from 1.494 to 2.810. The posttest demonstrates a significantly larger effect size, with a Cohen's d value of 9.816 and a confidence interval of 7.274 to 12.349, indicating a significant improvement. The delayed posttest demonstrates a substantial effect size, with a Cohen's d value of 5.312 and a confidence range of 3.902 to 6.713. The substantial effect sizes indicate that the intervention had a notable and enduring influence on performance overall assessment periods.

Performance of Experimental Group in Punctuation Tests

After the thorough analysis of the control group, the next step was to measure the progress of the experimental group from pretest to posttest and to delayed posttest; therefore, another Wilcoxon test was run to measure the effects of the treatment (i.e., using a chatbot to receive extra explanations and practice), and the results are shown in Table 5.

Table 5 indicates the presence of statistically significant differences in all the sets. The Z values for the comparisons between the posttest and pretest (Z = -4.787), the delayed posttest and pretest (Z = -4.788), and the delayed posttest and posttest (Z = -4.498) are all very significant, with p-values of 0.000. The findings suggest notable improvements in scores between the pretest and posttest, as well as between the pretest and delayed posttest. Additionally, there was a significant disparity between the posttest and delayed posttest scores. This suggests that the intervention led to significant and lasting improvements in performance over time. To further analyse the amount of difference within the experimental group in each set, Cohen's d was calculated, and Table 6 below presents the effect size results.

Table 6 illustrates substantial improvements in the experimental group across all testing intervals. The pretest yielded a Cohen's d value of 2.158, indicating a substantial initial effect. The 95% confidence interval for this effect is from 1.494 to 2.810. The posttest demonstrates a significantly greater effect size, with a Cohen's d value of 14.564 and a confidence interval ranging from 10.816 to 18.304, indicating a substantial and noteworthy improvement. The delayed posttest demonstrates a significant effect size, with a Cohen's d value of 13.482 and a confidence interval ranging from 10.009 to 16.946. The results underscore the substantial and enduring impact of the intervention on the experimental group's performance, surpassing the levels observed in the control group.

Comparison of Experimental and Control Groups in Punctuation Tests

Table 3

The Results of the Wilcoxon Test for the Control Group

	posttest - pretest	Delayed posttest - pretest	Delayed posttest - posttest
Z	-4.789	-4.237	-4.800
Asymp. Sig. (2-tailed)	.000	.000	.000

Table 4

The Effect Size in all the Tests in the Control Group

		Standardizer	Point Estimate	95% Confidence Interval	
				Lower	Upper
Pretest	Cohen's d	3.80018	2.158	1.494	2.810
posttest	Cohen's d	1.80325	9.816	7.274	12.349
delayed posttest	Cohen's d	2.10227	5.312	3.902	6.713

Table 5

The Results of the Wilcoxon Test for the Experimental Group

	posttest - pretest	Delayed posttest - pretest	Delayed posttest - posttest
Z	-4.787	-4.788	-4.498
Asymp. Sig. (2-tailed)	.000	.000	.000

After measuring learners' performance within their groups, it was necessary to compare the performance of each group across all sets of tests. Table 7 below presents the descriptive statistics for the control and experimental groups in the pretests, posttests, and delayed posttest.

Table 7 shows that the mean scores for the control group's pretest, posttest, and delayed posttest were 8.20, 17.70, and 11.16, respectively, while the mean scores for the experimental group's pretest, posttest, and delayed test were 8.06, 26.66, and 24.16, respectively. In both groups, as indicated by their mean scores, the average score of students on the posttest was higher than on the pretest and delayed posttest, and this comparison favours the experimental group. However, to better understand the differences between the groups, a Kruskal-Wallis Test was conducted, and the effect sizes of each set of tests are presented in Table 8.

Table 8 results reveal significant differences between the control and experimental groups' scores at different testing stages. For the pretest, the Kruskal-Wallis H value is 0.000 with a p-value of 1.000, indicating no significant difference between the groups and an epsilon-squared (ε^2) of -0.017, suggesting no effect size. However, for the posttest, the Kruskal-Wallis H value is 43.882 with a highly significant p-value ($p < 0.001$) and an ε^2 of 0.739, indicating a large effect size. Similarly, the delayed posttest has an H value of 44.628, with a highly significant p-value ($p < 0.001$) and an ε^2 of 0.752, signifying a large effect size. These results demonstrate that, although the groups started with similar performance levels, the intervention had a substantial and lasting positive impact on the experimental group's performance in both the posttest and the delayed posttest.

DISCUSSION

This study investigated the effectiveness of an interactive WhatsApp chatbot in enhancing the proficiency of Omani English as a Foreign Language (EFL) learners in using English punctuation marks. The findings demonstrated that the experimental group, which received supplementary training

Table 6

The Results of Effect Size within the Experimental Group in all Sets

		Standardizer	Point Estimate	95% Confidence Interval	
				Lower	Upper
pretest	Cohen's d	3.80018	2.158	1.494	2.810
posttest	Cohen's d	1.61352	14.564	10.816	18.304
delayed posttest	Cohen's d	1.54771	13.482	10.009	16.946

Table 7

The Descriptive Statistics for all the Tests in Two Groups

	N	Min	Max	Mean	Std. Deviation
Con_Pre	30	1.00	15.00	8.200	3.800
Con_Post	30	14.00	21.00	17.700	1.803
Con_Delayed	30	7.00	15.00	11.166	2.102
Exp_Pre	30	1.00	13.00	8.066	3.741
Exp_Post	30	23.00	30.00	26.666	1.971
Exp_Delayed	30	20.00	27.00	24.166	1.315
Valid N (listwise)	30				

Table 8

The Results of the Kruskal-Wallis Test for the Comparison of both Groups

	pretest	posttest	Delayed posttest
Kruskal-Wallis H	.000	43.882	44.628
df	1	1	1
Asymp. Sig.	1.000	.000	.000
ε2	-0.017	0.739	0.752

via the chatbot, significantly outperformed the control group across all testing phases, including the posttest and delayed posttest. This suggests that incorporating chatbot-assisted instruction into language education can yield measurable and lasting improvements in learners' mastery of specific linguistic features, such as punctuation. These results expand the breadth of current research by demonstrating the efficacy of chatbots in the specialised domain of punctuation, which is currently underrepresented in the AI-driven writing instruction literature. This finding strengthens the theoretical framework of form-focused education by validating that precise, targeted feedback delivered through technology may increase the cultivation of micro-level writing skills. Additionally, it aligns with sociocultural theory since the chatbot functioned as a scaffolding medium that promoted learners' development through interaction.

The observed progress within the control group can be attributed to both groups' classroom-based instruction. This finding aligns with the established pedagogical understanding that explicit instruction and consistent exposure lead to gradual improvement in form-focused language features such as punctuation (Fang & Wang, 2011; Macken-Horarik & Sandiford, 2016). However, the notably greater gains in the experimental group underscore the added value of chatbot integration as a mode of technology-enhanced learning. This result reinforces prior findings from studies highlighting the educational potential of mobile-based interventions, particularly in contexts that require frequent individualized practice and feedback (Abdul Fattah, 2015; Ivanova et al., 2022). The relationship between chatbot feedback types and learner engagement in form-focused training remains unclear. This study indirectly investigated this connection through its design. The chatbot intervention extends beyond traditional methods by employing constructivist ideas that enable learners to create their meaning through interaction, feedback, and adaptation. These are all essential parts of the personalized learning model.

The WhatsApp bot contributed to enhanced performance through several mechanisms. First, it facilitated immediate corrective feedback and individualised learning pathways based on learner performance, unlike the delayed and generalised feedback provided to the control group. Such responsiveness likely promoted greater learner engagement and more efficient error correction, factors emphasized in prior research on intelligent tutoring systems (Essel et al., 2022; Duong & Suppasetseree, 2024). Moreover, the chatbot's adaptive feedback and structured decision-tree logic correspond with key principles of practical formative assessment and scaffolding in second language acquisition. This demonstrates that mobile chatbots can serve as cost-effective and scalable alternatives to more complex AI teaching systems. This is an area that needs additional research in schools with limited resources. The effectiveness of these formative feedback loops reinforces the necessity of integrating AI-driven instructional designs into conventional English as a Foreign Language (EFL) teaching, especially in contexts where teacher-student ratios limit individualised attention.

Second, the chatbot afforded repeated and self-paced practice opportunities that are rarely possible in traditional classroom environments. The benefits of spaced repetition and self-regulated learning, both of which were operationalized in this study's intervention design, are well-documented in language pedagogy literature (Chen, 2024; Kwon et al., 2023). This automated interaction model enabled learners to gradually internalise complex punctuation rules through contextualised repetition. A subsequent study might benefit from a more comprehensive analysis of learner interaction logs to enhance comprehension of the cognitive mechanisms involved during chatbot usage. This strengthens the metacognitive dimension of second language acquisition, wherein learners cultivate awareness of their linguistic production and progressively improve their accuracy via autonomous engagement. This process is less achievable with teacher-centered instruction alone.

The findings further echo those of previous studies involving similar mobile-assisted writing interventions. For instance, Al-Wasy and Mahdi (2016) demonstrated that Saudi EFL learners using self-editing applications on mobile devices significantly improved in identifying punctuation errors. Likewise, the present study corroborates Vázquez-Cano et al. (2021), who showed that a Spanish-language chatbot significantly enhanced university students' punctuation performance. Additionally, Abdul Fattah (2015) reported positive outcomes from using WhatsApp-based instruction to enhance paragraph writing, with a particular focus on punctuation accuracy. Thus, the chatbot intervention employed here appears effective and consistent with international trends in mobile-mediated language instruction. Even so, the global studies mentioned show promising outcomes, but they differ in terms of technology interface, language focus, and assessment criteria. This makes it difficult to compare them and underscores the need for a standardised approach to evaluating AI-assisted writing therapies. This study fills a gap in the literature by providing data on a widely used platform (WhatsApp) and a well-defined linguistic subskill (punctuation), which improves the consistency of the evidence base for cross-study comparison.

In another study with similar findings, Črček and Patekar (2023) evaluated the frequency with which Croatian university students use ChatGPT for writing assignments, their performance, and their ethical perceptions. An online questionnaire completed by 201 university students from both state and private institutions gathered data. Evidence showed that more than half of the respondents use ChatGPT to create ideas, summarize, paraphrase, and proofread text; a high percentage also use it to write parts of their projects. The study identified the immediate need for institutions to establish clear ethical standards for the use of artificial in-

telligence software in scholarly activities. The focus on usage patterns and ethical considerations, while important, reveals a conceptual gap in the research on the influence of AI tools on learners' development of writing skills, an aspect our study addresses by emphasising educational outcomes rather than mere tool adoption. This study prioritizes pedagogical performance over utilitarian access, shifting the focus toward outcomes-based evaluation of AI integration in language education.

Additionally, the study's findings are consistent with those of Enamorado and Angel (2025), who found that the development of ChatGPT has generated significant excitement about its use in learning situations. The study investigated how 91 students of University of Valencia's English 2 course integrated the use of ChatGPT with English for Tourism Purposes (ETP) teaching. Targeted exercises, such as reading, vocabulary building, and role-plays, were conducted by students under the guidance of electronic devices and ChatGPT. The study centered on ChatGPT's learning efficacy, specifically its precision and ability to improve language skills. Through the presentation of interactive, feedback-driven exercises, ChatGPT clearly improves students' writing, communication, and vocabulary gains. Although output accuracy needs to be monitored by the teacher, the program's capability for emulating real-life communication situations in a short preparation time makes it an effective tool for directed and independent learning. Nonetheless, preliminary research in this emerging domain has pinpointed the specific linguistic or emotional attributes most affected by AI interaction, particularly in resource-constrained or high-stakes academic environments. This study fills that gap by giving controlled, skill-specific data on how chatbots might be used to help people learn English as a foreign language. Thus, it contributes to the current discussion by providing a context-sensitive, skill-specific framework that may aid future research on utilizing AI in EFL instruction in specific areas.

Importantly, the pedagogical value of such interventions lies in their performance outcomes and in promoting learner autonomy. The experimental group had access to learning tools outside the classroom, allowing for practice during otherwise idle moments, an approach in line with microlearning principles (Mohammed et al., 2018; Bruck et al., 2012). This kind of out-of-class support may be especially crucial for students in EFL contexts who lack exposure to English outside the academic setting. This study highlights the importance of low-barrier interventions that align with contemporary informal learning trends by situating chatbot utilization within learners' everyday digital practices. This has implications for the development of more ecologically valid language learning systems. This underscores that mobile-centric, feedback-rich microlearning facilitates learners in attaining academic objectives while fostering autonomous language development, a vital aim in modern language teaching.

Limitations

First, although the overall sample size (n = 60) was adequate for quantitative analysis, the absence of qualitative data limits its insight into learners' perceptions and experiences with the chatbot. Second, the study was conducted within a single institutional and cultural context, which may constrain generalizability. Lastly, while the chatbot focused on five punctuation marks selected based on curricular analysis, future studies may wish to include a broader range of punctuation features to further validate the tool's comprehensiveness.

Future research should consider expanding the participant pool to include learners from multiple institutions, varying levels of language proficiency, and diverse demographic backgrounds. It is also recommended that future studies employ mixed methods designs to capture both learning outcomes and user experiences in greater depth. Investigating the chatbot's efficacy across other domains of language learning (such as syntactic accuracy, paragraph cohesion, or pragmatic competence) would also be valuable. Additionally, integrating voice-based chatbot interaction could further personalize instruction and support learners with limited literacy skills.

CONCLUSION

This study has provided empirical evidence supporting the effectiveness of an interactive WhatsApp chatbot's effectiveness in improving English punctuation among Omani EFL learners. By integrating a process-oriented, learner-responsive tool into the learning environment, the study demonstrates how mobile-assisted technologies can enhance writing accuracy in a measurable and pedagogically meaningful way.

The experimental group, which received supplemental instruction through the chatbot, outperformed the control group in immediate and delayed posttests. These results indicate short-term learning gains and sustained retention of punctuation rules, suggesting that mobile-based interventions can support long-term language development. The chatbot's design (featuring individualized feedback, self-paced engagement, and decision-tree logic) proved an effective mechanism for reinforcing language conventions often neglected in traditional instruction.

The study contributes to the growing literature on mobile-assisted language learning (MALL) and offers a scalable solution for improving writing mechanics in resource-con-

strained or exam-oriented educational contexts. Nevertheless, certain limitations remain. The relatively small sample and lack of qualitative data limit the generalizability and explanatory depth of the findings. Future studies should consider larger, more diverse participant groups and incorporate learners' reflections and interaction logs to gain a deeper understanding of user experience and engagement patterns.

Ultimately, this study underscores the potential of integrating intelligent chatbot technologies into formal and informal language instruction. As digital platforms continue to expand their role in education, targeted applications like the one developed here offer promising avenues for personalised learning, particularly in areas such as punctuation, which often receive limited instructional attention.

DECLARATION OF COMPETING INTEREST

None declared.

AUTHORS' CONTRIBUTIONS

Ali Al Ghaithi: conceptualization; writing – original draft; software.

Behnam Behforouz: formal analysis, writing – review and editing.

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APPENDIX 1

The Pretest of Puncuation Marks

English Punctuation Pretest

General Instructions:

You are going to answer 30 questions in total, divided into three sections. Read each instruction carefully. You may not use a dictionary or mobile phone. Write clearly and review your answers before submitting the test.

Section 1: Sentence Correction (10 marks)

Instruction: Each sentence below contains one or more punctuation errors. Rewrite the sentence using correct punctuation.

Example:

✗ he said i am going to the store now

✓ He said, “I am going to the store now.”

1. what time is the class starting
2. I bought apples bananas oranges and grapes
3. its raining outside take your umbrella
4. My friend who lives in Muscat is visiting me today
5. I cant believe it she really passed the exam
6. I read the article titled the effects of climate change
7. Yes I agree with you
8. She said she would arrive by 5 pm
9. The movie was good however the ending was disappointing
10. Dr Smith will join us tomorrow for the lecture

Section 2: Multiple Choice (10 marks)

Instruction: Choose the punctuation mark that correctly completes the sentence. Circle the correct option (A, B, or C).

Example:

What did she say___

A. . B. ? C. !

✓ Correct answer: B

1. Do you like coffee ___
A. . B. ? C. !
2. I have three pets ___ a dog, a cat, and a parrot.
A. : B. ; C. ,
3. It’s raining outside ___ don’t forget your coat.
A. , B. . C. ;
4. She shouted ___ “Watch out!”
A. , B. : C. ;
5. The meeting is on Monday ___ May 5.
A. , B. - C. :
6. Mr ___ Al Saidi is our new teacher.
A. , B. . C. :
7. I have visited Muscat ___ Nizwa ___ and Salalah.
A. , / , B. ; / , C. , / and
8. “That’s amazing” ___ he said.
A. , B. ! C. .
9. She is a hard-working ___ honest student.
A. , B. ; C. -
10. They brought everything ___ plates, spoons, and cups.
A. : B. ; C. ,

Section 3: True/False Statements (10 marks)

Instruction: Read each sentence carefully. Decide whether the punctuation used is correct. Write 'True' if it is correct and 'False' if it is incorrect.

Example:

I can’t wait to see you!

✓ True

1. My uncle, who lives in Salalah is coming to visit.
2. Please bring the following items: pencils, erasers and rulers.
3. What a beautiful day it is.
4. “Are you ready to go” she asked.
5. He said, that he would be late.
6. Let’s meet at 6:00 pm.
7. No I haven’t seen your notebook.
8. He asked me if I liked pizza?
9. Tomorrow, we’ll visit the museum.
10. This is Johns book.