

## AI-Assisted Feedback Bots in Pakistani ESP Classrooms: Improving Writing Proficiency and Learner Autonomy

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### Abstract

**Purpose:** This research explored the potential of the integration of AI-assisted feedback bots as a tool to enhance the writing proficiency of undergraduate ESP learners in Pakistan.

**Method:** Utilizing a Mixed Methods Action Research approach, this study evaluated the impact of AI-assisted feedback bots on writing proficiency, demonstrated by the substantial increase in post-test scores. The qualitative content analysis highlighted the AI bot's role in providing structured guidance, task-specific assistance and promoting learner autonomy, though some students preferred traditional feedback methods.

**Findings:** The study concluded that AI-assisted feedback can serve as a valuable complement to traditional feedback methods, provided it is integrated thoughtfully.

**Keywords:** *AI, Writing, Formative Feedback, mixed methods action research.*

## 1. Introduction

In Second Language learning theories, feedback holds a significant position as a form of motivation (Hyland and Hyland, 2019). Over the last two decades, developments in SLA writing altered the domain of feedback mechanisms. Traditional teacher-written comments were replaced by peer reviews, writing workshops, personal conferences, learner corpora, and digital feedback methods (Bitchener and Storch, 2018). Research suggests the positive impact of computer-mediated feedback systems on students as they foster a sense of motivation along with spontaneous error correction (Chen, 2016). Moreover, Automated Writing Evaluation Systems (AWEs) also became popular as that they provide effective feedback to students while relieving the teachers from the stress of mechanical grading (Stevenson, 2016). Furthermore, with the advent of ChatGPT in 2023, the whole field of L2 learning is witnessing an interesting tilt towards AI chatbots (Kohnke et al., 2023). The early research on Generative AI has observed that AI chatbots can provide spontaneous feedback to language learners, thus making them more autonomous (Srinivas et al., 2022). However, there is a growing need to understand the impact of AI chatbots on learners' development of writing in various settings.

In South Asia, English gained momentum due to historical, political and economic reasons and is now seen as a medium of global communication (Kachru, 1998; Mahboob, 2009). Pakistan, a linguistic melting pot of more than 60 languages has given Urdu the status of national language which serves its purpose as lingua franca for the speakers of the country (Rahman, 2005). Despite the diverse linguistic landscape in Pakistan, English remains to play a role as the official language for higher education (Rahman, 2020; Shamim, 2008). English for Specific Purposes is critical for students aiming to participate in global markets, academia, and industries where English proficiency is required (Anthony, 2018; Coffey, 1984). However, teaching of English in Pakistani ESP classrooms have often been limited by a lack of resources (Zafar, 2009), larger class sizes (Panhwar & Bell, 2023), outdated curricula (Bashir, Yasmin & Ahmed, 2021), and inadequate teacher training (Hussain, Nawaz & Bhatti, 2022). Research suggests that ESP teachers are unable to provide personalized feedback to students due to large classes, which often causes hindrances for learners and teachers (Panhwar & Bell, 2023; Sharif & Zeeshan, 2023). This shortfall in formative assessment practices severely restricts opportunities for individualized improvement in language skills (Amir, Ullah & Kaleem, 2021; Ferris, 2003). Therefore, Pakistani ESP classrooms, characterized by unique socio-cultural and educational dynamics, offer compelling environments for exploring the effective use of AI-assisted feedback mechanisms to enhance writing proficiency.

Globally, AWEs have garnered attention of ELT practitioners as they can provide instant and personalised feedback to students (Woodworth & Barkaoui, 2020). However, there is a critical gap in understanding how these tools can be effectively customized to meet the unique needs of learners in diverse educational contexts, such as Pakistani ESP classrooms. This study argues that the one-size-fits-all nature of current AWE tools is insufficient, particularly in contexts like Pakistan, where there is an urgent need for AI-assisted feedback mechanisms that are contextually tailored. By exploring the potential of a customized AI-assisted feedback bot for Pakistani undergraduate students, this research seeks to address these gaps, offering insights into how AI can enhance learner autonomy and writing proficiency in challenging educational environments.

For this study, the AI-assisted feedback bot was intentionally designed to provide targeted feedback, limited to a maximum of 100 words, focusing exclusively on technical writing. By

constraining the bot's responses and preventing it from drafting complete documents, the bot aimed to encourage students to actively engage with the feedback. Over a trial-and-error period of approximately two months, the bot was rigorously tested by both students and educators, allowing for iterative refinements that ensured its alignment with the course objectives. This study also discusses how AI-assisted feedback bots can be integrated into Pakistani ESP classrooms. We contend that by integrating the instant and automated features of ChatGPT technology through a Zapier bot, English teachers can address the various challenges of teaching technical writing to undergraduate students.

## 2.1. Automated Writing Evaluation Systems

In the domain of ELT classrooms, the inclusion of AWEs has been receiving great attention due to their potential to enhance language learning in innovative ways. While AWE tools have been increasingly used at all educational levels, they are more commonly introduced in higher education, specifically in English composition classrooms and ESL/EFL academic writing courses. Their use varies depending on instructional needs, with some teachers using AWE for lower-level concerns while complementing it with personal feedback for higher-order issues (Stevenson, 2016). Despite their widespread use in formative assessment, AWE tools are criticized for overly relying on automated, prescriptive feedback (Shermis & Burstein, 2003).

AWE originated from Automated Essay Scoring (AES) but differs by focusing on formative feedback, covering a wide range of writing genres beyond just scoring. AWE tools align with individualized teaching and assessment, promoting learner autonomy and motivation. AWE tools can be categorized into two types based on feedback origin: Assessment-Driven AWE tools provide corrective feedback focusing on grammar, syntax, and discourse traits such as Grammarly and CyWrite. The second type of AWE tools include Genre-Based AWE which provides feedback based on rhetorical conventions of specific genres, with tools like Research Writing Tutor (RWT) and AcaWriter (Cotos, 2022). Moreover, Cotos (2022) predicted that a new generation of AWE tools is likely to emerge combining features of both assessment and genre-based tools. This evolution would utilize the capabilities of Intelligent Tutoring Systems with animated agents to create interactive, strategic and data-driven feedback tailored to different stages of the writing process (Banwan et al., 2022). Therefore, the progress in AWE technology highlighted the potential for the integration of AI-driven tools to effectively address challenges in writing development by providing real-time formative feedback to students. Hazelton et al. (2021) have also argued that the future of formative AWE may best be guided by the standpoint theory of action, which accounts for digital-technology mediation of the writing construct, pedagogical actions and the intended and unintended consequences of using AWE tools. Despite advancements in AWE technology, the field has yet to develop a universally effective solution for writing development, particularly in non-Western educational contexts.

Drawing on Vygotsky's socio-constructivist theory (1978) and Tomasello's Usage-Based Theory (2003), this study contends that AI-assisted feedback mechanisms can be more than just a supplement to traditional teaching methods—they can transform the way writing is taught and learned in ESP classrooms. By incorporating this theoretical framework, the research aims to design an AI-assisted feedback bot that not only aligns with the pedagogical goals of ESP courses but also addresses the cognitive and metacognitive needs of Pakistani undergraduate students,

a group that has been largely overlooked in the existing literature. Such a careful deployment of AI-assisted feedback bots into language learning classrooms can also eliminate the risk of limitations that AWE tools pose to learners learning writing skills to achieve the ideal test scores because of the automated scoring algorithms (Weigle, 2013).

## 2.2. AI bot in ELT Classrooms

The integration of AWE into language learning classrooms is not a new practice but it has been present in the form of AI dialogue systems, such as chatbots and virtual assistants. These AI dialogue chatbots simulate natural human dialogue using NLP techniques, achieved through machine learning or deep learning (Zhai & Wibowo, 2022). This innovation has changed the field of language learning by promoting learner autonomy, motivation and independent learning. The origins of language-learning applications utilizing dialogue systems can be traced back to ELIZA, the first NLP software in the 1960s. ELIZA was designed to mimic conversation through pattern matching, demonstrating the superficiality of human-machine interaction (Weizenbaum, 1976). This pioneering work paved the way for subsequent chatbot inventions, including the use of AI Markup Language to design dialogue systems for EFL learning which was quite instrumental in the development of communicative competence among learners (Mastura, 2021). Moreover, research has constantly shown that chatbots provide distinct advantages in educational settings. They are patient, able to respond instantly in natural language, reduce learner anxiety, and encourage communication and self-correction (Bibauw et al., 2019; Coniam, 2014; Fryer et al., 2020). However, despite these advantages, there is a critical need to understand the impact of these tools on learner's language skills, specifically in underrepresented contexts like Pakistani ESP classrooms.

Notably, Kim et al. (2022) specifically examined the impact of AI-integrated Mobile-Assisted Language Learning (MALL) on Korean students preparing for the Test of English for International Communication (TOEIC). The researchers reported an improved performance in learners when they used a chatbot before engaging in listening and reading tasks, thus highlighting the importance of AI tools in language learning proficiency. Moreover, Huang et al. (2022) also developed the Genie Tutor chatbot for learning English as a Foreign Language (EFL), which enables dialogue-based interactions focusing on specific language areas like ordering food or engaging in free conversation about diverse topics. These studies highlighted the potential of AI-integrated tools in language classrooms to enhance language learning outcomes, yet there remains an urgent need to explore how such AI tools can be adapted for South Asian contexts where access to resources and linguistic challenges differ significantly.

Sparking the interest of educators, the emergence of advanced chatbots like ChatGPT has revolutionized language teaching and learning. Educators and researchers have been exploring ChatGPT's potential to enhance language learning through its ability to produce coherent and detailed responses (Liu et al., 2023). Moreover, ChatGPT can adjust text difficulty to align with learners' proficiency levels (Bonner et al., 2023). Additionally, ChatGPT supports guided writing processes aiding students in becoming more self-reliant and addressing their need for instant feedback (Kohnke et al., 2023). It can deliver expert, human-like assistance in idea generation, text organization, accuracy, and vocabulary selection (Tai et al., 2023). Moreover, Wang and Guo (2023) also explored how ChatGPT can assist students in learning grammar and vocabulary. These findings demonstrate the effective role that ChatGPT has played in the various aspects of language

learning and writing skills (Dai et al., 2023; Mizumoto & Eguchi, 2023). However, the potential benefits of tools like ChatGPT are not without significant drawbacks. The concerns around factual accuracy and the tendency for students to over-rely on copy-pasting ChatGPT-generated responses raise critical questions about academic integrity and the ethical use of AI in education (Yan, 2023). Therefore, the future course of studies should be oriented towards innovative strategies concerning the effective deployment of GPT technologies into existing pedagogical frameworks without replacing essential human interaction in language learning yet promoting ethical and autonomous language learning.

### 3. Methodology

The study is grounded in Vygotsky's socio-constructivist learning theory (1978) and Tomasello's Usage-based Theory (2003). Vygotsky's theory posits that knowledge is actively constructed through social interactions and collaboration in the Zone of Proximal Development. The integration of AI-assisted feedback bots served as a tool to facilitate this construction by providing personalized and timely feedback, fostering a collaborative learning environment. Tomasello's theory argues against a pre-wired Language Acquisition Device, suggesting instead that language learning emerges from social interaction and functional language use, where learners develop grammatical competence through "statistical learning" by observing language in real contexts (Tomasello, 2003).

The study employed MMAR to investigate the integration of an AI-assisted feedback bot in ESP classrooms, aiming to both assess its utility and refine its application in large Pakistani classrooms that limit personalized feedback. MMAR's integration of qualitative and quantitative data provided a comprehensive understanding of the intervention. Quantitative data from paired t-tests measured outcomes, while qualitative data offered insights into student interactions and perceptions. This mixed-method action research approach enhanced the study by evaluating both the effectiveness and the user experience of the AI tool.

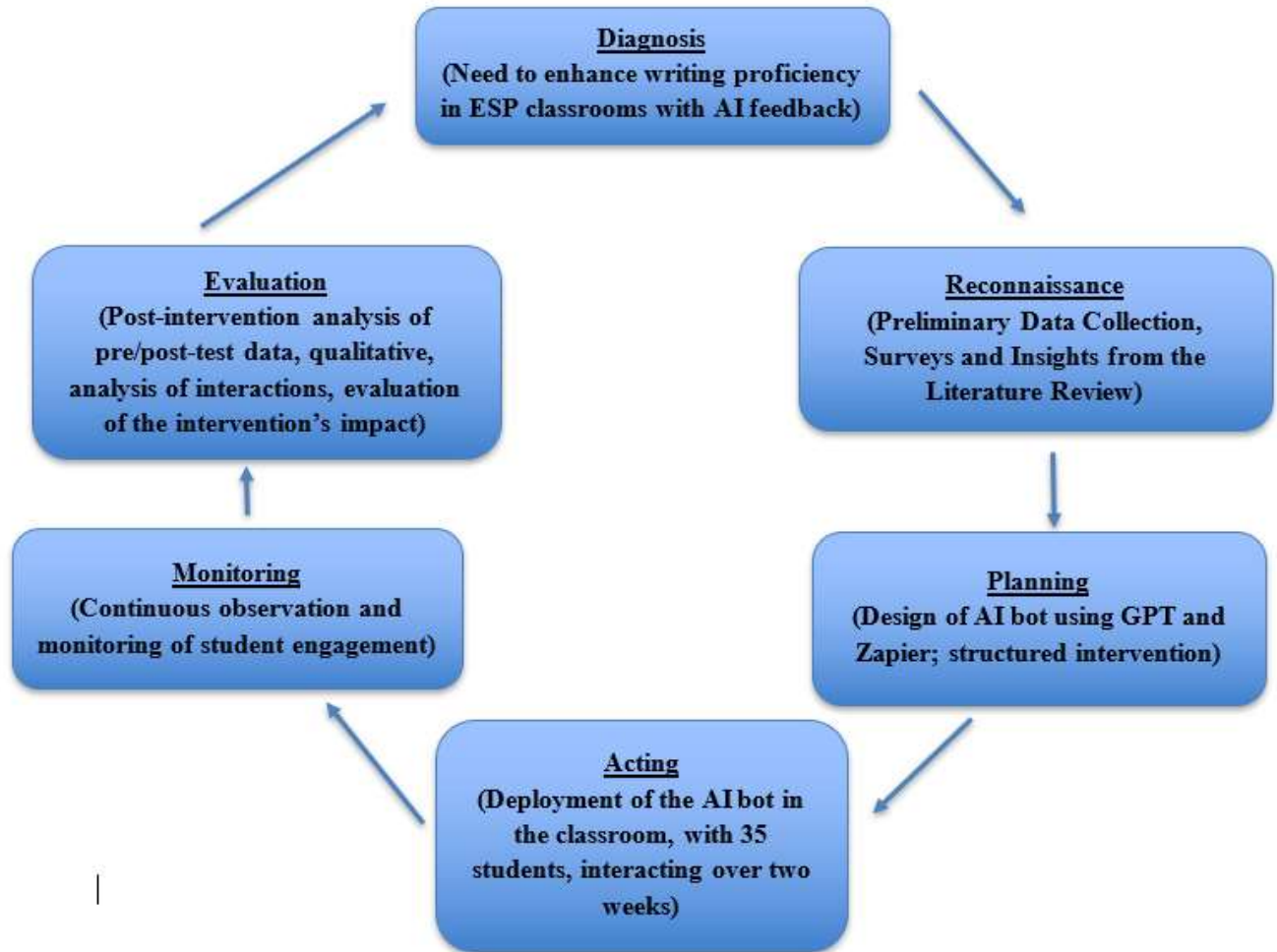


Figure 1 Flowchart showing the stages of an educational intervention using AI feedback bot in ESP classrooms.

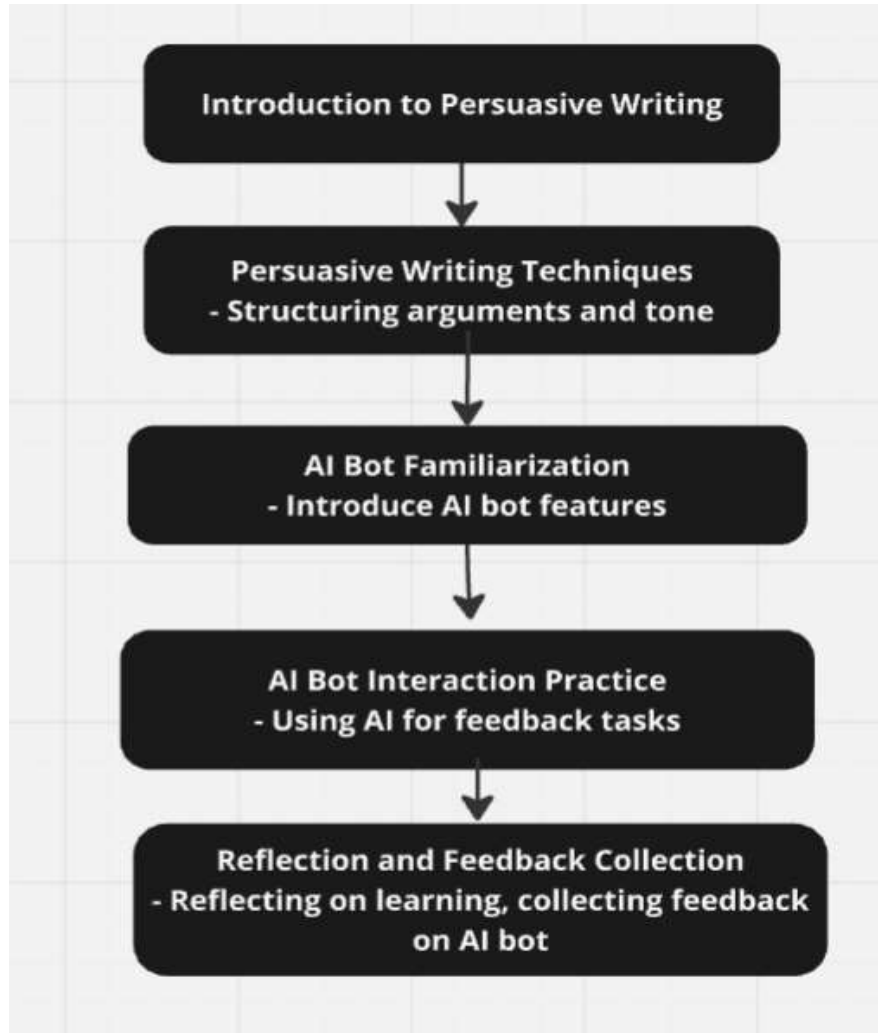
Adopting the MMAR framework by Ivankova & Wingo (2018), this study followed six iterative cycles:

1. **Diagnosing:** Identified the need to enhance writing skills among undergraduate students in large ESP classrooms in Pakistan, where personalized feedback is limited. MMAR was selected to iteratively develop and refine the AI-assisted feedback bot.
2. **Reconnaissance:** Collected preliminary data on student writing proficiency through surveys and reviewed literature on AI in language learning.
3. **Planning:** Designed an AI-assisted feedback bot using GPT technology integrated with Zapier, and developed a deployment strategy, including task designs, implementation timelines, and data collection methods such as pre- and post-tests.
4. **Acting:** Deployed the AI bot in the classroom, where 35 students engaged with it over two weeks to receive personalized writing feedback.

5. **Monitoring:** Observed student engagement and feedback relevance, adjusting the AI interface as necessary to align with educational objectives.
6. **Evaluation:** Analysed quantitative data from pre- and post-tests to assess writing improvements and qualitative data to identify interaction patterns. The findings guided further modifications of the AI bot for future iterations.

#### 4. Methods of Data Collection

According to the tents of purposive sampling, this study involved approximately 35 undergraduate students from ESP classrooms at an intermediate proficiency level, selected based on their willingness to integrate AI tools into their writing processes, as indicated in preliminary surveys. To establish a baseline, a pre-test assessed the students' initial writing skills, specifically their ability to produce coherent and contextually appropriate texts. This task required students to transform an impersonal email into a professional one, emphasizing effective vocabulary and grammatical accuracy. Subsequently, over a two-week intervention period, students focused on mastering persuasive writing techniques and familiarizing themselves with an AI-assisted feedback tool. During this phase, students practiced drafting persuasive emails as advocating for treadmill desks, continuously refining their drafts based on feedback from the AI tool. A summary of this intervention phase is presented in Figure 2.



*Figure 2 Flowchart showing steps of intervention*

Following the intervention phase, a post-test was administered to evaluate improvements in the students' writing proficiency. Unlike the pre-test, the post-test involved writing a more complex business report in email format, requiring persuasive writing and business communication. This task assessed not only linguistic proficiency but also the students' ability to engage in problem solving and strategic thinking. Students were expected to justify their writing choices, demonstrating competence in persuasive and effective business communication. The evaluation of the writing tasks was based on rubrics developed by the researcher and a co-teacher, validated by two experts in applied linguistics. The rubrics included criteria such as content, organization, grammar, and vocabulary. Reliability of the assessments was confirmed with Cohen's Kappa values above 0.8, indicating strong inter-rater reliability.



## 5. Analysis

### 5.1. Efficacy of AI-Assisted Feedback Bots

The collected data were analysed to examine the potential utility of AI-assisted feedback bots among ESP learners. The pre-test and post-test results were compared using paired t-tests to identify significant changes in writing proficiency by using SPSS. The analysis aimed to determine the effectiveness of the AI feedback in improving the student's writing skills, particularly in terms of content organization, grammar, vocabulary, and the overall coherence of their writing (Jacobs et al., 1981). The paired t-test results showed that the mean difference between pre-test writing tasks and post-test writing tasks is -8.286, where the average score of pre-tests was 7.757 and the post-test score was 16.043. This negative difference between the mean scores indicated an increase in the scores following the integration of an AI-assisted feedback bot, suggesting a positive impact on the writing proficiency of ELT learners. Moreover, the results of this paired t-test highlighted a two-tailed p-value, which is less than 0.0001, far below the conventional alpha level of 0.05 used to determine statistical significance. This extremely low p-value indicated that the observed difference in mean scores of the pre-test and post-test is highly unlikely to have occurred by chance, depicting a stark difference in writing proficiency after integrating an AI-assisted feedback bot. Furthermore, the results also reported a t-statistic of 17.4550, which is extremely high, measuring a startling difference between the pre-test and post-test scores relative to the variability in the sample data. To conclude, the difference between the mean scores of this paired t-test pinpointed that the integration of an AI-assisted feedback bot had a statistically positive effect on the writing scores of the students. In addition to that, the large t-value along with the extremely low p-value confirmed that these results are not just statistically important, but they signify the importance of AI-assisted feedback bots in ESP classroom settings. The data summary of the paired t-test is given below in *Table 1*.

*Table 1 Data Summary of Pre-Test and Post-Test Scores*

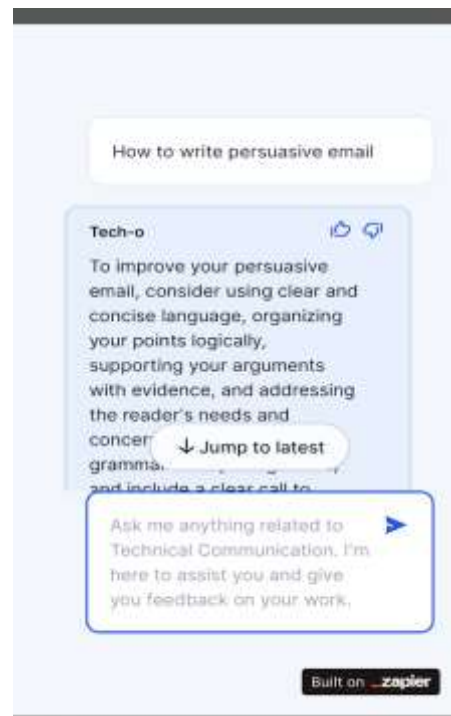
	Mean	SD	SEM	N
Pre-Test	7.757	1.516	0.256	35
Post-Test	16.043	1.953	0.330	35

### 5.2. Structured Guidance and Task-Specific Assistance

The qualitative data, including student feedback and screenshots of interactions with the AI bot, were subjected to qualitative content analysis. This analysis sought to identify patterns and

themes in the students' use of the AI-assisted feedback bot, providing a deeper understanding of how the AI-assisted feedback influenced their writing process. In the interactions between students and an AI-assisted feedback bot, several interconnected themes emerged and proved that language can be acquired through exposure to linguistic patterns, particularly about the cognitive processes involved in noticing these patterns (Flowerdew, 2015; O'Keefe, 2020).

It was observed that the AI-assisted feedback bot played a crucial role in structuring communication. Through "Instructional responses" to "How-to-Queries" of students, the AI bot guided students on how to organize their emails clearly and logically. This feedback was foundational, as it ensured that language emerges from its use within social and communicative environments, with frequency, recency, and context playing significant roles in how linguistic forms are acquired and processed (Ellis, 2012). By structuring the email properly, students also ensured that their main arguments were presented coherently, by asking for feedback revisions from the AI bot. For instance, the instructional responses provided by the AI bot to "How-to Queries" offer more than mere information; they actively engage students in cognitive processes that mirror how language is used in real-life settings. This type of interaction provided students with repeated exposure to the structures and vocabulary relevant to specific tasks, such as writing a persuasive email, thereby aligning with the Usage-Based Theory's emphasis on the importance of frequency and recency of exposure (Tomasello, 2003).



*Figure 3 Screenshot of an AI tool interface named "Tech-o" showing a conversation about how to write a persuasive email.*

Moreover, the responses of students from the feedback surveys also reflected a spectrum of user experiences ranging from "impressive capabilities" and "accurate answers", which highlighted the effective learning support and practical utility of AI-assisted feedback bots. Moreover, a student also pinpointed that, "Getting real-time feedback without any delay was interesting because having a teacher's opinion at 2 am while writing a cover letter is not possible". The capability of

an AI-assisted feedback bot to provide structured guidance and task-specific assistance aligned with Vygotsky's theory which suggests that learning is enhanced through socially mediated interactions. The AI-assisted feedback bot, through its human-like responses and practical utility, functions as a digital "more knowledgeable other," guiding learners through tasks and providing support where needed. The AI-assisted feedback bot's effectiveness in providing practical utility also suggests it can scaffold learning in a way that helps students navigate their Zone of Proximal Development (ZPD), allowing them to accomplish tasks that they might not be able to do independently (1978).

Despite the established utility of AI-assisted bots, when the students were asked about their preference for AI-assisted feedback over traditional feedback methods (teachers and peers), their responses provided an intriguing comparison. The responses like "AI feedback is more informative and well explained" contrasted with "Teachers and peers give better, more personal feedback." This finding indicated a tug-of-war between the convenience and efficiency of AI and the depth and personalization of human feedback. Notably, some of the students also reflected that "AI doesn't provide detailed explanations sometimes" and "AI feedback is detailed but sometimes biased". This finding captured the limitations of AI-assisted feedback and highlighted the need for careful integration of AI tools in ESP classrooms to supplement rather than replace human interactions. The comparison in Traditional vs AI-assisted feedback drew attention to the trade-offs between AI's efficiency and the personalization of human feedback. This finding mirrored the Usage Based Theory's principle that not all exposure leads directly to learning; contextual feedback often aids in deeper understanding (Tomasello, 2003). This limitation of AI-assisted feedback bot highlighted a key area for future AI development, aiming to emulate more natural, human-like interactions (Pérez-Paredes et al., 2020).

### **5.3. Enhanced Engagement and Learner Autonomy**

In the students' interactions with the AI-assisted feedback bot, it was noticed that the AI bot assisted students in justifying their proposals by providing facts and examples. Through factual and explanatory responses to "Informational queries", the AI bot equipped the students with the demonstrative responses providing them with necessary data, detailed rationale along with examples on how treadmill desks can boost health outcomes and workplace productivity which was the requirement of the writing task. This not only strengthened the persuasive nature of the emails but also provided concrete guidance to support the argument's nature. Therefore, the interactions with AI-assisted feedback bot were crucial in bridging the gap between theoretical knowledge and practical application, making learning more accessible and engaging for students. For instance, the student inquired about the effective subject line for drafting an email and asked the AI-assisted feedback bot to provide an example.

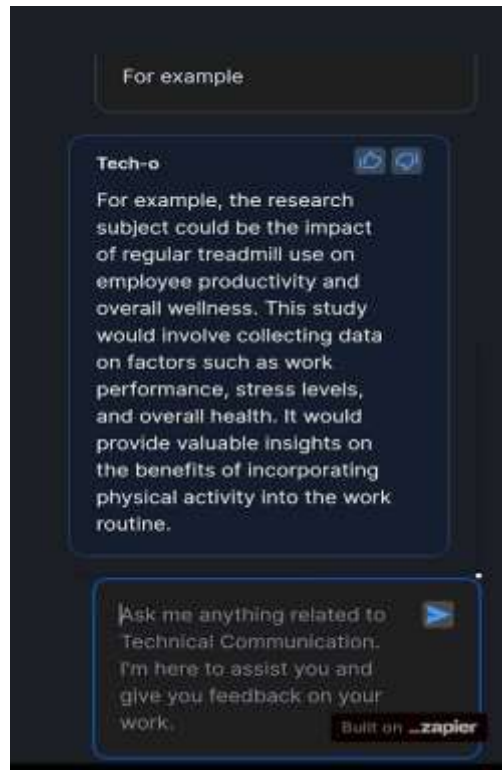


Figure 4 Screenshot of “Informational Queries”

This enhanced interactive feature of the AI-assisted feedback bot is in line with the findings from the feedback surveys in which students found the interactions with the AI-assisted feedback bot to be “more engaging than traditional methods” providing them with “simpler and faster understanding”. The students also remarked that the AI-assisted feedback bot was “more immersive, more personalised than other chatbots” and one of the students felt that it was “more engaging than Google searches”. The design and functionality of the AI-assisted feedback bot’ interface are well-aligned with users’ needs, making it easy for them to navigate and interact with the bot effectively which was also proved by the survey result in which 96.9% of the students believed that the interface of the AI-assisted feedback bot was friendly and accessible. Only a small fraction of respondents (3.1%) indicated that they did not find the interface user-friendly, which could point to minor areas for improvement. Overall, the high percentage of positive responses highlights the success of the AI-assisted feedback bot in providing a user-centric experience that facilitates engagement and accessibility.

Was the interface of the AI-bot user friendly and accessible for you?  
For reference: <https://tech-o.zapier.app/chat>

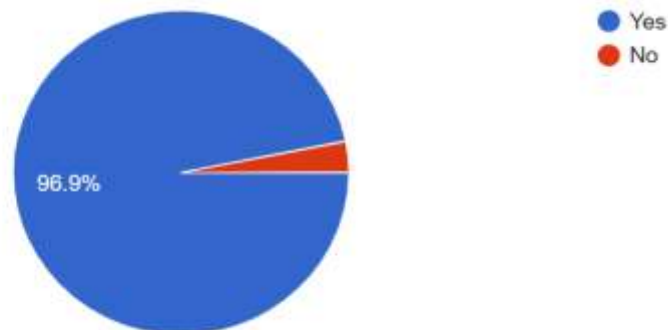


Figure 5 Survey Result 1

Furthermore, the students enjoyed the language learning process as the AI-assisted feedback bot made “class more fun and interactive”. This positive experience was reflected in their responses related to “improved learning curve” and “detailed feedback on mistakes”. The interactive and user-friendly nature of AI-assisted feedback bots made them “feel like talking to a human” which made the language learning process, more engaging. This personalization is pivotal, as it aligns with the importance of context and individualized learning experiences in language acquisition (Ellis & Larsen-Freeman, 2006). By simulating human-like interactions and adapting responses to the needs of the learner, AI bots can mimic the naturalistic language exposure that Usage Based theory finds crucial for effective learning.

The interactive and adaptive nature of the AI-assisted feedback bot also empowered the students to manage and direct their language learning processes as it responded to “Recommendation and Feedback queries” with suggestive and evaluative comments. By doing so, the AI-assisted feedback bot helped refine the students’ approach towards writing. This included crafting compelling subject lines and improving the draft’s clarity and engagement level. This evaluative feedback was vital as it also proved that the AI-assisted feedback bot encouraged the students towards self-correction. This was also proved by the survey results where a significant majority of respondents (87.5%) reported that the AI-assisted feedback bot involved them in self-correction. This suggested that the AI-assisted feedback bot is effective in promoting self-regulated language learning behaviours among users, encouraging them to identify and correct their own mistakes rather than relying solely on external feedback. This autonomous feature of AI-assisted feedback bot was also highlighted in the feedback surveys when the students voiced out that “AI bots are available 24/7, they can be accessed with one single click” and “AI guides self-learning”. Contrary to these students, a smaller portion of respondents (12.5%) did not feel encouraged to self-correct, indicating that while the AI-assisted feedback bot is largely successful in this regard, there may be some users who do not experience the same level of benefit.

Has the AI bot encouraged you to self-correct more often?

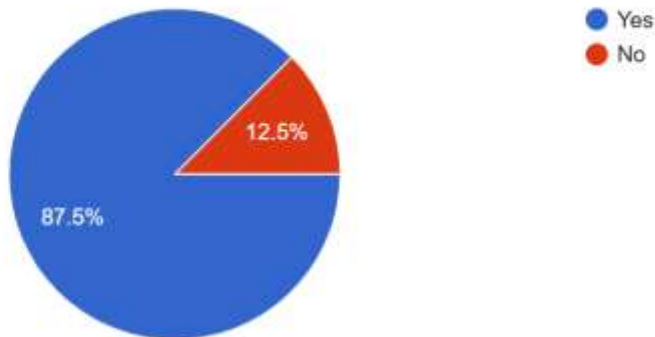


Figure 6 Survey Result 2

These respondents were concerned about an increased cognitive dependency on AI, as highlighted that “the dependency on AI inhibits learning from mistakes.” This suggested that while AI can foster an independent learning environment, there should be a delicate balance to maintain to ensure that such tools are enhancing rather than hindering educational growth. Vygotsky’s theoretical assumptions of the Zone of Proximal Development (1978) suggest that scaffolds should be gradually removed as competence increases, thus if AI makes certain processes too easy or immediate, it might limit opportunities for learners to struggle and consequently grow through those challenges.

## 6. Discussion and Findings

The advent of technology and Artificial Intelligence (AI) provides a unique opportunity to address these limitations by enhancing language learning through innovative tools and methodologies (Benabdallah, 2023). AI and data-driven learning approaches, such as corpus-based analysis, offer personalized feedback and insights into language usage patterns that are particularly beneficial for ESP students (Su et al., 2021). Therefore, this study incorporated AI-assisted feedback in Pakistani ESP courses to resolve the issue of limited personalised feedback in large class sizes. The significant improvement in post-test scores highlighted the potential of AI-assisted feedback bots to fill this critical gap. The substantial increase in post-test scores, with a mean difference of -8.286 and a highly significant p-value ( $< 0.0001$ ), strongly suggested that AI-assisted feedback can effectively enhance students’ writing skills. The high t-statistic (17.4550) further emphasised the reliability of these results, indicating that the observed improvements were not due to chance but were a direct outcome of the intervention. This indicated that Automated Writing Systems can provide the much-needed individualized attention that Pakistani students require to enhance their writing proficiency in ESP courses. These findings aligned with previous research that highlighted; the role of Automated Writing Systems in providing immediate, targeted feedback that can address specific linguistic and structural issues (Calfee & Miller, 2007; Fan,

2023; Ferris & Hedgcock, 2023). However, while the quantitative data provides clear evidence of the AI-assisted feedback bot's effectiveness, it is essential to contextualize these findings within the broader scope of language acquisition theories. The Usage-Based Theory posits that language learning is heavily influenced by the frequency and recency of exposure to linguistic patterns (Tomasello, 2003). The AI-assisted feedback bot's ability to provide repeated, context-specific feedback aligns with this theory, suggesting that its utility extends beyond mere correction to actively facilitating the internalization of language structures.

The qualitative results revealed a promising picture of student perceptions regarding AI-assisted feedback versus traditional methods. While many students appreciated the immediacy and detail of AI feedback (Nazari, Shabbir & Setiwan, 2021), others preferred the depth and personalization provided by teachers and peers (Kaivanpanah, Alavi & Sepehrinia, 2015) reflecting the deeply ingrained cultural influences of Pakistani context (Nawab, 2012). This "tug-of-war" between AI efficiency and human empathy also highlighted a critical consideration for educators: AI tools should be seen as complementary to, rather than a replacement for, human interaction. The comparison of AI feedback to traditional methods also raised questions about the limitations of AI in providing contextually rich feedback. As noted by some students, AI sometimes failed to offer detailed explanations or was perceived as biased (Ferrara, 2023). This limitation points to the need for further development of AI systems to better mimic the depth of human feedback, potentially through the integration of more advanced natural language processing algorithms (Pérez-Paredes et al., 2020). Moreover, these findings also resonated with Vygotsky's concept of the Zone of Proximal Development (ZPD), where learning is optimized when guided by a "more knowledgeable other" (Vygotsky, 1978). In this context, an AI-assisted feedback bot has served as a digital knowledgeable other, providing scaffolding that helps students achieve tasks they might not accomplish independently.

Furthermore, the study has timely responded to Pakistan's national educational policy's call for integrating technology into the curriculum to foster learner autonomy and critical thinking skills (Government of Pakistan, 2018). The AI-assisted feedback bot's ability to engage students in self-correction by providing 24/7 support is particularly relevant to the Pakistani context. Therefore, the study aligned with national efforts to modernize educational practices and equip students with the skills necessary for independent learning in a rapidly changing global context. The positive feedback from students regarding the AI-assisted feedback bot's role in enhancing engagement and making learning more interactive suggested that AI tools can significantly contribute to creating a more student-centred learning environment (Lin, Huang & Lu, 2023). However, the concern raised by a minority of students about increased cognitive dependency on AI is a crucial point of discussion (Zhai & Wibouw, 2022). While AI can facilitate learning, there is a potential risk of diminishing students' ability to engage in deep and reflective thinking if the tool is used as a crutch rather than a guide (Rezaei, Salehi & Tabatabaei, 2024). As educational institutions in Pakistan integrate more AI-driven tools, it is vital to ensure that these technologies are used to complement, rather than replace, critical thinking and problem-solving skills, thereby avoiding the risk of superficial learning.

## 7. Conclusion and Implications

In conclusion, the integration of AI-assisted feedback bots in Pakistani ESP classrooms presents a promising solution for enhancing writing proficiency. The quantitative and qualitative data from this study suggested that AI can provide effective, immediate feedback that supports language acquisition and promotes learner autonomy. However, the findings also highlighted the importance of balancing AI assistance with human feedback and ensuring that AI tools are used for supplementation, rather than replacement of traditional teaching methods. By carefully integrating AI into the learning process, educators can harness its potential to create more engaging, personalized, and effective language learning experiences. The findings from this study have several implications for future research and practice.

Firstly, there is a need to explore how AI-assisted feedback can be tailored to provide more contextually rich and personalized responses, perhaps through the incorporation of corpus-driven tools and data-driven learning that can be adapted to individual learner profiles. Data-driven learning fosters the language learning process in ELT classrooms by encouraging the learners to analyse authentic language use by making inferences about language rules and patterns (Boulton and Cobb, 2017). Secondly, the integration of AI in language learning should be accompanied by pedagogical strategies that encourage students to critically engage with the feedback they receive, rather than passively accepting it, thus enhancing the role of ZPD and scaffolding. Through language teachers, learners should be given “frames for thinking on their own” (p.163, Vygotsky, 1978). The future research could also examine the long-term effects of AI-assisted feedback bots on language learning outcomes, particularly in relation to the development of higher-order cognitive skills through longitudinal research studies. Additionally, future studies could investigate the effectiveness of AI feedback across different linguistic and cultural contexts, considering how these variables might influence the interaction between students and AI tools.



### Disclosure Statement

The author(s) declare no conflicts of interest with respect to the research, authorship, and/or publication of this article. No financial support was received for the research, authorship, and/or publication of this article.

### Additional Information

### Notes on Contributors

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**Dr. Salma Kalim** is an Assistant Professor in the Department of English at the International Islamic University, Islamabad (IIUI), Pakistan. She earned her Ph.D. in Rhetoric and Composition from Miami University, USA, and was awarded the 2022 President’s Dissertation Award. Dr. Kalim has been invited to present and publish her research on various international platforms. Currently, she serves as the In-charge of the Department of English at IIUI.

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