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The impact of ChatGPT feedback on the development of EFL students' writing skills

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ABSTRACT

This study investigates the effectiveness of ChatGPT feedback in enhancing the writing skills of Gen Z students, who constitute a significant portion of today's global population. Utilizing a mixed-methods approach, the research explores both quantitative and qualitative aspects of students' interactions with ChatGPT in the context of foreign language education. A quasi-experimental design was employed, involving 110 university students learning English as a Foreign Language (EFL). Through pre-tests, post-tests, questionnaires, and focus group interviews, the impact of ChatGPT feedback on students' writing proficiency was evaluated. Quantitative analysis revealed significant improvements in various aspects of writing, including conciseness, grammar, inclusion of key information, and the use of passive voice, following ChatGPT feedback. Qualitative insights from focus group interviews corroborated these findings, with students expressing positive perceptions of ChatGPT's role in enhancing their writing skills. Overall, the study demonstrates the potential of ChatGPT as an innovative educational tool for fostering writing proficiency among Gen Z students. The findings underscore the importance of integrating AI-driven technologies into language learning processes to meet the evolving needs of contemporary learners.

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1. Introduction

Nowadays, Gen Z students compose about 32% of the world's population (Moorthy, 2023). On one hand, they are often described as judgmental, not understanding, and stereotypical people while on the other hand, they are described as loyal, compassionate, thoughtful, open-minded, responsible, and determined (Seemiller & Grace, 2016). Whether individuals from Gen Z can fit themselves into this description is not known, however, they all have one thing in common, and that is being digital natives (Pearson, 2018; Seemiller & Grace, 2016). They are the first generation that does not know time without the Internet and as a result, they used various types of technology from a very young age (Miliou & Angeli, 2021; Mohr & Mohr, 2017; Pearson, 2018; Seemiller & Grace, 2016).

Not only have Gen Z students grown up using technology in their free time, but technology is also present in their studies. Whether it is simply creating presentations, or using virtual reality, interactive simulations, and augmented reality, technology provides an engaging way for Gen Z students to learn (Kilag et al., 2023). The interconnection between the use of technologies and learning is reflected in the development of education itself. Integration of technology in learning has been a crucial part of the 21st century. The aim of Education 4.0 was to see Industry 4.0 technology incorporated into education (the Internet of Things, artificial intelligence, machine learning, gamification) and by this to connect technologies already in use with education, society, and businesses. This approach emphasizes experiential learning, critical thinking, and digital literacy, aiming to prepare students for the modern workforce

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(González-Pérez & Remírez-Montoya, 2022; Himmetoglu, Ayduğ & Bayrak, 2020; Kim, 2022). Education 5.0, on the other hand, builds on these concepts by emphasizing a harmonious integration between human intelligence and technology, where AI not only supports but also collaborates with learners. It promotes adaptive learning environments that cater to individual learning needs, fostering critical thinking, creativity, and problem-solving skills through immersive technologies like augmented and virtual reality (Rane et al., 2023). Furthermore, Education 4.0 and 5.0 offer personalized approaches, an adaptive learning environment, and promote interactive and experimental learning (for example, using augmented reality in which students can engage in realistic situations) which are crucial for success in today and future world (Khandelwal et al., 2022; Rane et al., 2023).

The development of Education 4.0 is reflected in the usage of another piece of artificial intelligence (AI) tool called ChatGPT (Generative Pre-trained Transformer) which is used by numerous students worldwide. Since its launch at the end of 2022, ChatGPT became an instant phenomenon used by 100 million people around the world just a few months after its release (Rahimi & Abadi, 2023). What makes ChatGPT successful is its ability to generate flawless texts and answers to questions in a conversational style which makes it attractive for tasks such as summarizing and responding to questions (Aithal & Aithal, 2023; Hatmanto & Sari, 2023; Prananta et al., 2023; Sok & Heng, 2024; Tajik & Tajik, 2023). Furthermore, ChatGPT provides “information, performs text-related tasks, provides suggestions, and interacts naturally with users” (Prananta et al., 2023, p. 1032). Jagdishbhai and Thakkar (2023) made a list of ChatGPT’s advantages which include availability, efficiency, no human bias, and multilingualism. On the other hand, they describe its disadvantages as ChatGPT having limited knowledge, lack of empathy, inability to understand context, and misinformation. In education, ChatGPT can be used as a “self-directed learning tool, conversation simulation, and creative learning content provider”. Therefore, there is no wonder why ChatGPT quickly became a significant part of education. Despite its widespread use in education, the role of ChatGPT in enhancing English as a second language (ESL) learning, especially writing skills, remains an under-researched area. ESL is a key area for research because proficiency in writing is an essential skill for academic and professional success. Unlike other language skills, writing often requires extensive feedback and repeated practice. This makes it an ideal area to explore the impact of AI-driven tools such as ChatGPT, which can provide immediate feedback and suggest improvements. ChatGPT’s ability to provide personalized feedback, correct grammatical and syntactical errors, and create contextually relevant content puts it in a position to be a promising tool for ESL learners. It can help bridge the gap between classroom instruction and real-world language use, offering students a flexible and responsive partner on their language learning journey. In addition, ChatGPT can adapt to different learning styles due to its adaptability, making it a versatile resource for a variety of ESL learners.

Nowadays, ChatGPT is used by both teachers and students (Hatmanto & Sari, 2023; Prananta et al., 2023; Sok & Heng, 2024; Tajik & Tajik, 2023). For teachers, it has considerable potential as it provides an innovative approach toward teaching and furthermore, it can reduce the workload by generating lesson plans, syllabi, quizzes, activities, assignments, assessments, and more (Sok & Heng, 2024; Tajik & Tajik, 2023). By using ChatGPT, students may improve their “deep learning, critical thinking, and writing skills” (Tajik & Tajik, 2023, p. 4). Moreover, students can use ChatGPT as a learning companion that is an interactive and responsive tool always ready to help (Tajik & Tajik, 2023). Furthermore, both teachers and students may use ChatGPT instead of a search engine which usually generates a great number of results, and therefore, people have to take a considerable amount of time to get the correct answers to their questions. ChatGPT can provide effective and efficient answers saving time and effort (Sok & Heng, 2024). Naturally, there are also limitations to ChatGPT as it has been proven that it sometimes provides wrong information and therefore, the results should always be fact-checked (Aithal & Aithal, 2023; Hatmanto & Sari, 2023; Prananta et al., 2023; Sok & Heng, 2024; Tajik & Tajik, 2023). Another very serious problem is that ChatGPT can be misused by students to cheat on examinations, assignments, essays, and homework (Flanagin et al., 2023).

The usage of ChatGPT within foreign language education (FLE) has been a significant part of contemporary research (e.g. Amin, 2023; Hakiki et al., 2023; Hatmanto & Sari, 2023; Jagdishbhai & Thakkar, 2023; Katar et al., 2023; Khoso et al., 2023; Li, 2024; Songsingchai, Sereerat & Watananimitgul, 2023). Based on the results of the research studies of the authors mentioned previously, ChatGPT can be

used as an effective tool for FLE. For example, students can interact with it at their level of English proficiency, and they will get immediate feedback on grammar, punctuation, vocabulary, and more. ChatGPT is also able to help with understanding a text, it can summarize it or rewrite it in simpler language. It can provide explanations, examples, sources for further learning, exercises, and more. It can also be used as a translation tool, translating to or from English (Wang et al., 2020). Participants in Leleparry's et al. (2023) research study confirm that using ChatGPT within learning a new language has potential and even benefits such as increased student engagement, accessibility, collaboration, etc. On the other hand, Khoso et al. (2023) summarized the general concerns of students when using ChatGPT including distraction and overreliance, quality of information, ethical use and plagiarism, privacy, and security concerns. In the research study of Ivenz and Poláková (2024), the concerns were similar, as students stated that they found ChatGPT as not trustworthy, causing laziness, providing wrong answers, chaotic, and even scary.

The research study within this article focuses on improving the writing skills of Gen Z students via the usage of ChatGPT. It follows our previous article in which the majority of student participants declared that when it comes to the development of skills, technology can be most effective and helpful in developing writing skills (Ivenz & Poláková, 2024). When students copy their texts to ChatGPT, it can give them feedback, suggest improvements, answer difficult questions, provide further information, improve clarity of the text, reformat text, summarize thoughts (Ali et al., 2023; Megawati et al., 2023; Nafea et al., 2024; Songsiengchai, Sereerat & Watananimitgul, 2023). For advanced writers, it can "outline documents, create bulleted lists, and modify text to different readerships" (Nafea et al., 2024, p. 2). This research aims to find out whether students' writing skills improved after ChatGPT's feedback in several categories and whether they were able to sharpen their writing skills based on this feedback.

2. Methodology

In this study, a quasi-experiment was chosen as the research design (Figure 1), aiming to investigate the improvement of students' writing skills through the utilization of ChatGPT as a writing assistance tool. The research employed both quantitative and qualitative approaches to assess the impact of ChatGPT feedback on enhancing students' writing proficiency. Initially, students completed a questionnaire to assess their strengths and weaknesses in writing, as well as to express their expectations regarding the use of ChatGPT in the foreign language learning process. Content analysis was employed to interpret questionnaire responses. Following this, students wrote summaries, serving as pre-tests, with ChatGPT gathering data on students' writing skills based on specified criteria. In the post-test phase, students revised their summaries based on ChatGPT feedback given in the first session, and their writing improvement was again evaluated and analyzed using ChatGPT. The post-test phase provided an opportunity to measure the impact of ChatGPT's feedback on students' writing skills, focusing on specific criteria such as grammar, structure, clarity, and content. This approach aimed to identify quantifiable changes in students' writing proficiency. Additionally, the focus group was used in order to gather subjective feedback on student' experience with GhatGPT, exploring their views on the usefulness of the tool, and perceived benefits or drawbacks. Content analysis was utilized for focus group interview data.

A quasi-experimental design was chosen to provide a structured but flexible approach to studying the impact of an intervention - in this case, the use of ChatGPT as a tool to guide writing. This design

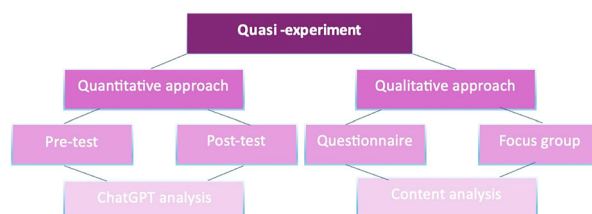


Figure 1. Research design.

allows for a controlled experiment while accommodating real-life learning contexts in which random inclusion is not always possible. According to Maciejewski (2018), the combination of quantitative and qualitative methods facilitates a comprehensive analysis of both measurable outcomes and subjective experiences.

This mixed-methods approach was employed to address the following **research question**:

“Can students improve their writing skills through the utilization of ChatGPT feedback?”

The chosen methodology is appropriate for exploring this research question because it allows researchers to collect and analyze both quantitative and qualitative data and offers a comprehensive view of the impact of ChatGPT. Quantitative data from pre-tests and post-tests provide measurable evidence of improvement, while qualitative insights from focus group interviews offer context and depth for understanding students' experiences. In addition, content analysis allows for the systematic examination of open-ended responses and group discussions, providing a thorough examination of themes and patterns.

The **hypothesis** for the research question was formulated as follows:

“There is a significant improvement in students' writing skills through the utilization of ChatGPT feedback.”

This research methodology introduces a novel approach through the integration of a quasi-experimental design with advanced feedback with the support of artificial intelligence, specifically through ChatGPT. This hybrid methodology allows for a flexible yet structured study that captures the quantitative aspects of writing skills while providing a qualitative view of the student experience. An innovative aspect is the direct use of AI in an iterative process of feedback and revision, with students using ChatGPT to improve their writing. By combining quantitative pre-tests and post-tests with qualitative data from focus group interviews, this approach facilitates a multifaceted evaluation of the role of AI in improving students' writing skills, bridging the gap between traditional educational methods and modern technology.

2.1. Research sample

In this study, 110 university students, aged between 19 and 23 years old, all engaged in learning English as a Foreign Language (EFL), formed the research participants. The investigation took place within the Professional English classes during the winter semester of 2023/2024. It is important to mention that the research participants were students of different study programs (Applied Informatics; Economics and Management), and have varying levels of English proficiency, reflecting a diverse range of learning needs. However, these differences were not seen as a barrier to conducting this research. Additionally, it is essential to acknowledge that the research was conducted by the article authors, who are instructors for the Professional English classes. Given their roles, the convenience sample of students was chosen, emphasizing the practicality and feasibility of conducting research within their teaching environment.

2.2. Research instrument

The research instrument utilized in this study was ChatGPT, an advanced language model developed by OpenAI. Capable of generating human-like text based on the received input, ChatGPT employs deep learning techniques to understand and respond to natural language coherently and appropriately (Ray, 2023).

In the context of this study, ChatGPT was employed to evaluate and analyze student writing skills, focusing on various aspects such as conciseness, inclusion of key information, grammar, use of passive voice, integration of linking words, and use of reporting verbs. Initially, students interacted with ChatGPT to receive personalized feedback, providing valuable insights and suggestions for enhancing their writing skills. Subsequently, researchers utilized ChatGPT to collect data on students' writing proficiency and analyze the progress and development of their writing skills. By examining the outcomes generated by ChatGPT, researchers could assess student improvements in writing over time.

2.3. Research procedures

The research was conducted during the winter semester of 2023/2024, over three sessions. In the first session, students were asked to fill in a questionnaire focused on identifying their perceived weaknesses and strengths in writing, as well as their expectations towards ChatGPT. Following this, students were given two texts (Lyubych & Gulseren, 2023; Abbas, 2023), each related to different topics (IT; economics). They were instructed to choose one of them for reading. Subsequently, students were required to write a summary of their chosen text, following the guidelines provided by the instructors. After completion of their summaries, students engaged with ChatGPT by providing both the original text and their summary for assessment. They then prompted ChatGPT to review their summaries and compare them to the original text, evaluating different aspects. Students submitted their pre-questionnaires, summaries, and ChatGPT feedback to their instructors for further evaluation. The purpose of this intervention was to examine the effectiveness of ChatGPT as a writing assistance tool in a classroom setting. It was hypothesized that AI-driven feedback would enable students to improve their writing skills by offering detailed, personalized feedback to help them improve their summaries. The aim was to test whether this intervention would lead to tangible improvements in students' writing skills.

In the second session, students were tasked with writing new summaries based on the feedback received from ChatGPT in the previous session. After revising their summaries, students once again engaged with ChatGPT, providing their summary from the first session, their revised summary from the second session, and the feedback received from ChatGPT during the first session. They then requested ChatGPT to assess their progress, by comparing the two summaries, and to provide feedback on improvement. Again, students were requested to submit their revised summaries along with the feedback provided by ChatGPT for further analysis. This phase was crucial to test whether the feedback provided by ChatGPT could lead students to measurable improvement in their writing. By comparing the first and second summaries, the study sought to validate the idea that consistent AI-driven feedback could positively impact Generation Z students' writing skills.

In the third session, a focus group interview was conducted to obtain additional qualitative information from the students regarding their experience with ChatGPT as a writing assistance tool. The focus group provided an opportunity for students to discuss their thoughts on the integration of technology in language learning in future educational settings. This session aimed to find out how students perceived the intervention and how using ChatGPT affected their approach to writing and learning. Qualitative focus group data allowed the researchers to explore the wider impact of AI tools on students' engagement and motivation to learn. This in turn provided insight into the potential benefits and challenges of integration of AI-driven tools into a language learning context.

3. Results

The results section provides a detailed analysis of the findings obtained from the study, focusing on the impact of ChatGPT feedback on students' writing skills. This section examined both quantitative data, obtained from the ChatGPT evaluations, and qualitative data gathered through a questionnaire and a focus group interview. The results provide information on student writing proficiency assessed by ChatGPT before and after receiving feedback. Additionally, the section explores students' approach to ChatGPT and their overall perceptions of this tool.

The questionnaire results, shown in Table 1, provide insight into students' perceptions and expectations regarding their writing skills and the potential role of ChatGPT in improving their overall writing proficiency. In terms of strengths in writing skills, perceived by the students before ChatGPT treatment, 35 students identified creativity as a notable strength, followed by rich vocabulary (18 students) and the ability to write concisely (17 students). Interestingly, a considerable number of students (21) did not identify any specific strengths in their writing skills. Conversely, when asked about weaknesses, the most commonly reported areas were grammar (40 students) and vocabulary (35 students). Other weaknesses including spelling, word order, and text structures, were identified by smaller numbers of students.

Regarding expectations from using ChatGPT in the process of foreign language learning, students expressed varied anticipations. The most common expectations included a desire for new ideas (19

Table 1. Students' perceptions of their writing skills and expectations regarding ChatGPT utilization.

Strengths	Students	Weaknesses	Students	Expectations	Students
No strengths	21	Lack of creativity	6	No expectations	6
Creativity	35	–	–	New ideas	19
Vocabulary	18	Poor vocabulary	35	Vocabulary improvement	21
Conciseness	17	Conciseness	5	Conciseness	2
Typing speed	7	Typing speed	3	–	–
Extensive writing	7	Extensive writing	4	Extensive writing	13
Grammar	2	Grammar	40	Grammar	35
		Formal English	6	Formal English	1
		Spelling	14	Spelling	6
		Word order	7	Word order	16
		Text structure	3	Text structure	13
				Translation	2
				Verified information	2
				Learning from own mistakes	6

Table 2. Chat GPT's evaluation of students' writing skill.

Aspects	Strengths	Weaknesses
Conciseness	59	39
Inclusion of key information	70	23
Grammar	64	34
Use of passive voice	58	37
Integration of linking words	64	32
Use of reporting verbs	64	29

students) and enhancement of vocabulary (21 students). Improvement of extensive writing (13 students), grammar improvement (35 students), and formal English writing (6 students) were also mentioned as expected outcomes. Additionally, 6 students expressed the expectation of learning from their own mistakes, while others anticipated benefits such as the use of verified information (2 students) and assistance with translation (2 students).

The research participants who were tasked with reading a text and subsequently writing a summary based on provided instructions, engaged with ChatGPT, prompting it to provide feedback on their writing. The results, as provided by ChatGPT, are summarized in Table 2 below. Notably, the students demonstrated strengths in aspects such as the inclusion of key information (70 students), grammar (64 students), conciseness (59 students), and the use of passive voice (58 students). However, weaknesses were also identified. A considerable number of students showed areas for improvement in conciseness (39 students), grammar (34 students), and the use of passive voice (37 students). Additionally, while the integration of linking words and the use of reporting verbs received relatively high scores for strengths (64 students), there were still notable numbers of students who showed weaknesses in these areas (32 students and 29 students).

To compare the results presented in Table 1 (students' perceptions) and Table 2 (ChatGPT evaluation), both indicate that grammar is an area for improvement, as a significant number of students identified it as a weakness (Table 1, 40 students; Table 2, 34 students). In addition, the ChatGPT results highlight conciseness as another area that needs to be improved, which is in line with the perceptions of students who acknowledged the ability to write concisely as a strength (only 17 students). Regarding the differences, while Table 1 highlights creativity and vocabulary as strengths, the ChatGPT emphasizes the inclusion of key information, grammar, and conciseness as strengths. Additionally, while students identify spelling as a weakness, this aspect is not explicitly mentioned by ChatGPT. Overall, both tables offer complementary insights into students' perceptions of their writing skills and the objective evaluation provided by ChatGPT, revealing areas of agreement and disagreement. The comparison between Tables 1 and 2 confirms that ChatGPT feedback can provide a comprehensive assessment of students' writing skills. The correspondence between students' perceived weaknesses and the objective feedback from the ChatGPT, particularly in the areas of grammar and conciseness, supports the view that the use of the ChatGPT can effectively identify and potentially address key areas for improving writing skills.

Table 3 below presents information regarding students' progress in writing skills through ChatGPT feedback. The research participants requested ChatGPT to assess their improvement by comparing two summaries. Across various aspects, notable strengths were identified, including the inclusion of key

Table 3. Students' improvement through ChatGPT feedback.

Aspects	Strengths	Weaknesses
Conciseness	69	17
Inclusion of key information	78	8
Grammar	71	13
Use of passive voice	70	18
Integration of linking words	68	20
Use of reporting verbs	67	13

information (78 students), grammar (71 students), and the use of passive voice (70 students). However, weaknesses were also observed, particularly in conciseness (17 students), the integration of linking words (20 students), and the use of reporting verbs (13 students).

Comparing the results from Tables 2 and 3 reveals significant improvements in students' writing skills assessed by ChatGPT. A larger number of students demonstrated strengths in conciseness, inclusion of key information, grammar, use of passive voice, integration of linking verbs, and use of reporting verbs in Table 3 compared to Table 2, while fewer students showed weaknesses in these areas. This comparison demonstrates the positive impact of ChatGPT feedback on enhancing students' writing proficiency. Regarding this, it can be concluded that the hypothesis that there is a significant improvement in students' writing skills through the utilization of ChatGPT feedback was supported by this study, and the research question was answered affirmatively. In other words, the findings underscore the effectiveness of ChatGPT feedback in facilitating students' writing skill development.

In order to gain qualitative insights from the students about their experiences with ChatGPT, a focus group interview was conducted. Interview questions included inquiries about the changes or improvements made in students' writing as a result of the feedback received from ChatGPT, the perceived helpfulness of ChatGPT's feedback, surprising aspects of ChatGPT's evaluation of students' writing, and the most challenging errors to be corrected after receiving feedback. Overall, the majority of the research participants (78) expressed positive feedback and perceived ChatGPT as a helpful tool to improve their writing skills. Many students (38) reported that they were surprised by the detailed assessment of their writing provided by ChatGPT, indicating its ability to identify areas for improvement. Conversely, a few students (4) reported poor feedback provided by ChatGPT, which lacked specific details. Some students also mentioned challenges in terms of revision of the summary, mostly the difficulty in correcting grammar, using the passive voice, and fixing the use of linking words and reporting verbs. Despite these problems, students identified improved aspects of their writing, such as making the text more concise, correcting grammar, improving punctuation, and fixing the use of linking verbs and reporting verbs, which is consistent with the results portrayed in Table 3. To illustrate the qualitative data, a few direct quotes from the focus group interview are provided to offer insight into students' experiences with ChatGPT:

"I was surprised at how much detail ChatGPT provided in its feedback.

"It pointed out specific grammatical errors and suggested ways to improve my vocabulary."

"Using ChatGPT helped me understand where I was making mistakes."

"The feedback was generally helpful, but I found it difficult to correct some errors."

"I expected more guidance on spelling and sentence construction."

"I was surprised by the suggestions for improving grammar and vocabulary."

These quotes reflect the different experiences and perceptions of the students regarding their engagement with ChatGPT. Although most students found the feedback useful and appreciated the detailed analysis, a few encountered difficulties in addressing certain aspects of their writing, such as correcting errors in passive voice and using appropriate linking words. However, the overall feelings from the focus group suggest that the ChatGPT made a positive contribution to improving students' writing skills.

In conclusion, the study revealed significant improvements in students' writing skills through the utilization of ChatGPT feedback, as evidenced by both quantitative and qualitative data, therefore it can be concluded that the research question "Can students improve their writing skills through the utilization of ChatGPT feedback?" was answered positively. Students demonstrated enhanced proficiency in

writing, which was also supported by their perceptions, as the majority of students expressed positive feedback and recognized ChatGPT as a valuable tool for improving their writing skills. These findings highlight ChatGPT's potential as an innovative educational tool in the foreign language learning process.

4. Discussion

The results of this study underscore several key findings regarding the utilization of ChatGPT as a writing assistance tool for Gen Z students in the context of foreign language education. The quantitative analysis revealed significant improvements in students' writing skills across multiple dimensions, including conciseness, grammar, inclusion of key information, and the use of passive voice. These findings align with prior research highlighting the improvement of writing skills among students (Barrot, 2023; Jeon, 2024; Shaikh et al., 2023; Songsiengchai et al., 2023). The results comprehensively address the research question, **"Can students improve their writing skills through the utilization of ChatGPT feedback?"** by demonstrating significant improvements in students' writing proficiency. Quantitative data from ChatGPT evaluations before and after feedback, alongside students' self-perceptions and expectations, indicate a clear alignment between the identified weaknesses and the improvements observed.

Moreover, the qualitative insights obtained from focus group interviews shed light on students' perceptions and experiences with ChatGPT. The significantly positive feedback from participants underscores the tool's potential to enhance engagement, accessibility, and collaborative learning experiences. Such positive results correspond with current research studies conducted around the world (Han et al., 2023; Marzuki et al., 2023; Silitonga et al., 2023).

However, it is also necessary to acknowledge the implications and challenges associated with the integration of AI-driven technologies into language learning contexts. The implications of this study for the foreign language learning setting are multiple. Firstly, it highlights the potential of ChatGPT to provide personalized feedback in the language learning environment (Escalante et al., 2023; Su, Lin & Lai, 2023). By using such tools, instructors can address specific areas that need to be improved. Additionally, the integration of technology into the language learning process can enhance students' engagement and motivation by providing innovative learning experiences (Songsiengchai et al., 2023). Furthermore, the findings suggest that combining traditional teaching methods with ChatGPT can lead to better learning outcomes. Moreover, integrating ChatGPT into the language learning process can help teachers with assessment. This tool offers objective and fair assessment and helps to understand students' language problems. Overall, the study provides robust evidence that ChatGPT feedback can significantly improve students' writing skills, supporting the hypothesis and offering valuable insights into the potential of AI-driven educational tools.

The study has several limitations that should be considered. Firstly, the use of a convenience sample consisting of university students might not apply to different groups of EFL students. Moreover, as the research was conducted within a single semester and focused on a particular language-learning context, the generalizability of the findings may be limited. Additionally, the qualitative data gathered from the focus group interview are subjective, which could introduce potential interpretation challenges.

5. Conclusion

The findings of this study illuminate the transformative potential of ChatGPT as a tool for enhancing the writing skills of Gen Z students in foreign language education. Through a comprehensive mixed-methods approach, encompassing quantitative evaluations and qualitative insights, the research provides compelling evidence of ChatGPT's efficacy in facilitating writing proficiency among university students engaged in English as a Foreign Language (EFL) studies.

Quantitative analysis revealed improvements across various dimensions of writing, including conciseness, grammar, inclusion of key information, and the adept use of passive voice. These enhancements, observed through pre-test and post-test assessments, underscore the tangible impact of ChatGPT feedback on students' writing abilities. Notably, the integration of AI-driven feedback mechanisms into the learning process empowered students to refine their writing skills with precision and efficiency.

Complementing the quantitative findings, qualitative data derived from focus group interviews offered insights into students' perceptions and experiences with ChatGPT. The positive feedback from participants underscores the tool's value as a resource for personalized writing support. Students expressed appreciation for ChatGPT's ability to provide detailed feedback, identify areas for improvement, and foster a deeper understanding of linguistic nuances. Moreover, students highlighted ChatGPT's role in promoting self-directed learning and fostering a collaborative learning environment. By leveraging ChatGPT as a dynamic writing companion, students reported increased engagement, accessibility, and confidence in their writing endeavors. The tool's capacity to offer immediate feedback and tailored suggestions resonated with students, empowering them to iterate and refine their writing compositions iteratively. These results together answer the research question "Can students improve their writing skills through ChatGPT feedback?" as quantitative improvements in various writing dimensions and qualitative support from student feedback suggest that ChatGPT plays a significant role in increasing writing skills. Furthermore, these findings are consistent with previous research (Khalifa & Albadawy, 2024) on AI-driven learning tools, strengthening the potential benefits of integrating such technologies into language learning. Specifically, this previous study suggests that AI-based platforms can enhance academic writing, and personalized learning and provide rapid feedback, echoing the results observed in this study.

Despite the positive results, certain limitations of the study should be noted. First, the convenience sample consisted primarily of undergraduate students who may not be representative of the broader EFL student population, limiting the possibility of generalizability. Future research should consider a wider demographic sample including different age groups, educational groups, and cultural contexts to confirm the findings. Another limitation is the short duration of the study, which may not be sufficient to assess the long-term effects of ChatGPT feedback on students' writing skills. Long-term studies could offer deeper insights into the lasting impact of AI-driven feedback mechanisms. In addition, the subjective nature of qualitative data obtained from focus group interviews introduces potential interpretative biases. To mitigate this problem, future studies could use other methods of qualitative data collection, such as individual interviews or reflective diaries. These methods could offer a broader view of students' experiences with tools using artificial intelligence in language learning.

While the study showcases the transformative potential of ChatGPT in bolstering writing proficiency, it also underscores the evolving landscape of technology-enhanced education. As educators navigate the complexities of integrating AI-driven tools into pedagogical practices, it is imperative to foster a culture of critical inquiry and ethical use. While ChatGPT offers unparalleled opportunities for personalized learning, educators must remain vigilant against potential pitfalls, including reliance on automated feedback and the risk of plagiarism. The literature (Rane et al., 2023; Kamalov et al., 2023) raises similar concerns about the integration of AI, highlighting the need for balanced use and continued human supervision to maintain academic integrity. This consistency with existing research supports the idea that while AI tools such as ChatGPT can be highly beneficial, they should not completely replace human feedback or the collaborative aspects of traditional learning environments.

Based on this study, future research could investigate the optimal integration of AI tools into traditional pedagogical frameworks, focusing on the balance between technology and human interaction. This could help educators find the right combination of AI-driven assistance and personal guidance. Further studies should also focus on ethical aspects such as plagiarism and over-reliance on AI-generated feedback to ensure the responsible use of these technologies in educational settings.

In conclusion, the present study contributes to a growing body of research on the intersection of technology and education, reaffirming ChatGPT's role as a catalyst for innovation in language learning. Moving forward, sustained efforts to harness the potential of AI-driven technologies hold promise for empowering learners and shaping the future of education in an increasingly digital age.

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Data availability statement

All data generated or analyzed during this study are included in this published article.

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