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RESEARCH PAPER

The Effectiveness of AI-Powered Corrective Feedback on Students' Writing Performance

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ABSTRACT

The objective of current research is to analyze the use of artificial intelligence (AI) in providing written corrective feedback for students on their essay writing. This study examines the effectiveness of AI-powered corrective feedback on students' writing performance in terms of its accuracy, pedagogical impact, and students' engagement. The study adopts a mixed-methods approach in order to explore students' writing development following AI-created feedback. Data were gathered from pre-and post-writing assessments, student surveys, and teacher evaluations in order to determine whether AI-driven feedback improves the quality of grammar, coherence, and overall writing proficiency. The results highlighted how AI-based feedback raises students' writing by providing immediate, tailored and stable corrections for enabling self-regulated learning. Yet, issues with contextual inaccuracies, over-reliance on AI, and lack of nuanced feedback for more complex writing elements are also covered. The study recommends that the valuable perspectives can be received on how pedagogical approaches can benefit from both AI-based feedback tools.

KEYWORDS AI-Powered Feedback, Corrective Feedback, Writing Performance, Automated Assessment, AI in Education

Introduction

In recent years, AI in education transformed writing instruction through automated corrective feedback to students. 1. Introduction Writing is a multifaceted cognitive activity in which students must develop skills in grammar, cohesion, coherence and argumentation (Hyland, 2019). Traditionally, teachers and peers have provided corrective feedback and research has shown it is effective in helping students improve writing accuracy and overall performance (Ferris, 2010). Yet, as enrollment numbers continue to climb and time becomes a less plentiful resource, educators sometimes hit a great wall in providing adequate feedback in a reasonable amount of time. AI-powered writing assistants like Grammarly, Turnitin's Revision Assistant and OpenAI's ChatGPT were the best thing that came out of this technology to help address these challenges (Li, Liu, & Hegelheimer, 2020).

AI based feedback systems use Natural Language Processing (NLP), and Machine Learning (ML) algorithms to assess students writing in immediate, personalized feedback (Ranalli, Yamashita, & Stockwell, 2022). Studies have indicated that providing given_fix-which often include detailed feedback on grammar, syntax, style, and clarity-on students' writing can be beneficial for the improvement of their writing performance (Zhai, 2022) In addition, AI judgment was shown to positively

impact student engagement by fostering autonomous learning and revising essays multiple times (Wang & Vasquez, 2021). However, apprehension can still be observed about AI's capacity to generate feedback that is nuanced and tailored, especially when it comes to evaluating higher level writing skills like argument expansion and rhetorical effectiveness (Stevenson & Phakiti, 2019).

Previous research contrasting AI-based feedback against human feedback has shown a disconnecting result. Although AI provides timely and consistent corrections, human feedback is often more contextually relevant and personalized to each student (Li & Meng, 2021). Moreover, some scholars also claimed that students' aluminate to be over-reliance on AI tools, which can impede their critical thinking and self-editing abilities (Zhang & Hyland, 2022). Considering these arguments, additional studies should investigate the potential of AI-based corrective feedback in enhancing students' writing performance at different proficiency levels and in various educational settings.

The purpose of this study is to examine the pedagogical effectiveness of AI-driven corrective feedback on students' writing ability versus traditional feedback approach. It aims to find out if AI-enabled tools improve writing ability, foster learner agency and assist teachers in providing effective feedback. The results will inform the current dialogue on how to effectively incorporate AI into writing instruction, influences best practices for the use of AI in education settings, and serve as impetus to educators to pilot the use of AI in writing instruction.

If something as fundamental as writing causes problems with grammar, coherence, or overall quality of composition in students for academic and professional settings that is indeed a cause for concern. The traditional corrective feedback that teachers provide is valid and effective, and yet is often limited by the teacher's reachable time in a high student to teacher ratio, which means feedback will be delayed (Ferris, 2010). The introduction of Artificial Intelligence (AI)-based writing tools as Grammarly, Revision Assistant from Turnitin, and ChatGPT from OpenAI serve a potential alternative because they provide instant, automated feedback on students' writing (Li, Link, & Hegelheimer, 2020).

Natural Language Processing (NLP) and Machine Learning (ML) are being used to create AI-driven feedback systems that detect errors, and recommend corrections to help improve student writing as they are typing. Studies show that AI-based corrective feedback improves writing performance by enhancing grammatical accuracy, increasing cohesion, and overall readability (Ranalli, Yamashita, & Stockwell, 2022). Furthermore, providing AI feedback can help develop learner autonomy, where learners take more responsibility for their revisions and learning process (Zhai, 2022). Yet important questions remain about the pedagogical implications of AI-assisted feedback, especially in relation to how it compares in effectiveness to teacher feedback, how it impacts students' critical thinking and revision strategies, and why these AI tools will fit into educational spaces (Wang & Vasquez, 2021).

Based on the above considerations, this study attempts to investigate the effectiveness of AI-based corrective feedback on students' writing performance on writing tasks. This research will explore the effectiveness of AI integrated into writing through examining its effects on various components of writing, and thus provide insights that highlight whether AI can be used as a supplementary or alternative form of writing feedback to human feedback.

While AI-powered writing tools are increasingly integrated into educational environments, there is little empirical evidence of their effectiveness in improving students' writing performance. Although AI feedback can give immediate and mechanised suggestions, issues remain regarding its accuracy and contextual fit, along with its potential to cover higher-order writing competences like argumentation and coherence (Stevenson & Phakiti, 2019). And while some students may find this feedback useful, true improvement in writing comes only when students engage with that feedback, a choice that is unclear how many will follow, and whether feedback will have lasting impact.

The purpose of this study is to fill these gaps by investigating the efficacy of AI-driven corrective feedback on the students' writing ability. We will compare AI feedback with traditional teacher feedback and investigate its impact on grammatical accuracy, cohesion and overall writing quality. In addition, the research will investigate students' perceptions of AI feedback and how they affect their revision strategies. These findings will add to the ongoing debate about the role of AI in education and make recommendations for integrating AI-assisted feedback in writing instruction.

Literature Review

Writing Instruction and Corrective Feedback

Corrective feedback (CF) serves an important function, assisting students in enhancing their writing performance by noting errors and helping learners arrive at a place of revision and improvement. What makes traditional teacher-provided feedback effective is that it provides contextualized explanations and scaffolding the student learning (Ferris, 2010). Meanwhile, the increasing number of students and time limitations make it difficult for teachers to provide thorough and individualized feedback to the students (Hyland, 2019). As a result, the focus has shifted to new feedback approaches like peer-to-peer feedback, computer-generated feedback, and AI-based corrective feedback.

Theoretical Foundations for AI-Powered Corrective Feedback

AI-Powered Corrective Feedback: The basis of AI-Powered corrective feedback is Natural Language Processing (NLP) and Machine Learning (ML) which allows automated writing tools to assess and evaluate student writing (Li, Link, & Hegelheimer, 2020). Feedback provided through AI is meant to offer real-time, individualized commentary on grammar, cohesion, style, and clarity (Ranalli et al., 2022). These systems are in accordance with the theory of formative assessment (Black & Wiliam, 1998) which suggests that learners learn more with timely feedback offered continuously, as well as with the theory of self-regulated learning (Zimmerman, 2002) that the adaptiveness of the learning environment contributes to the learning effectiveness.

Impact of Artificial Intelligence-Driven Feedback on Written Composition

In particular, there have been a number of studies investigating the effectiveness of AI-based corrective feedback on students' writing proficiency. According to several studies, writing feedback provided by AI can enhance the grammatical accuracy and lexical sophistication of learners (Zhai, 2022). In another comparative study, students who were provided with AI feedback wrote more accurate essays and developed a greater number of revisions than students who received teacher feedback (Li and Meng,

2021). In a similar vein, Wang and Vasquez (2021) found that AI-enabled tools such as Grammarly and Turnitin's Revision Assistant guided students in polishing their writing structure and improving cohesiveness.

Yet other research shows that AI feedback has less impact on complex writing features (e.g., argumentation, rhetorical effectiveness, and creativity) (Stevenson & Phakiti, 2019). AI tools often do not provide in-depth comments about critical thinking and argument development compared to human feedback (Zhang & Hyland, 2022). These findings highlight that although AI concepts have a positive effect on mechanical accuracy, other aspects of writing need to be supported by human guidance in the form of teacher feedback.

Students have low engagement and perceptions of AI feedback

Whether or not the feedback from an AI is effective largely depends on how engaged a student is with that feedback. Students generally do value immediate and consistent feedback from adaptive forms of AI feedback, enabling them to always update or revise their work on the fly (Ranalli et al., 2022). Moreover, AI feedback promotes learner autonomy, allowing students to revise their writing prior to submitting the final drafts (Zhai, 2022).

In contrast, various studies emphasize issues such as student engagement with teacher feedback generated by AI. For example, Stevenson and Phakiti (2019) reported that students typically took AI recommendations at face value without critical thought and made superficial changes to their texts rather than deeper learning. In a similar vein, some education researchers have identified concerns around whether AI can provide feedback that would be culturally and contextually appropriate for all students, including non-native speakers of English (Wang & Vasquez, 2021).

Challenges and Limitations of AI in Writing Instruction

Limitations of AI-Powered Corrective Feedback Despite its pros, AI-Powered Corrective Feedback is not without its limitations. The first major concern involves the accuracy and appropriateness of the corrections generated by AI, as these tools may misconstrue context and provide suggestions that are incorrect (Li & Meng, 2021). Moreover, dependence on AI could lessen the need for students to learn to edit their work independently and think critically (Zhang & Hyland, 2022).

Ethical concerns are also raised in connection with AI usage in education. Concerns about data privacy, algorithmic biases, and the potential displacement of human instructors have been hotly debated (Black & Wiliam, 1998). Which means educators need to walk a fine line, using AI-powered tools as an add-on, not a substitute, for teacher feedback.

Research shows AI-based corrective feedback has the potential to increase students' writing performance by offering real-time data-based feedback over grammar and cohesion. Yet its constraints in tackling complex issues of writing and in providing deep engagement point toward the need for a hybrid approach, one that combines AI-generated feedback with human attention. Future studies could investigate optimization of AI to make more differentiated feedback based, especially on writing skills with a higher cognitive level.

Material and Methods

Research Design

By employing a quasi-experimental design, this study investigates the impact of AI-powered corrective feedback on students' writing performance. The study treats the efficacy of AI-generated feedback on writing performance using a pre-test and post-test control group design, comparing AI-generated feedback conditions with traditional teacher feedback conditions. This study adopted quantitative and qualitative methods, which can provide a detailed assessment of how AI-enhanced feedback helps to improve writing.

Population and Sample of the Study

The target population of the study is the students enrolled in IELTS preparatory courses of Karachi. IELTS writing tasks are a good scenario of assessing AI-driven corrective feedback since these tasks typically comprise structured writing exercises with a special emphasis on coherence, grammatical accuracy, and task achievement.

A sample were drawn from the population that consists of the IELTS trainers from three different IELTS training centers Karachi. The estimated sample size was 60 students, and they were separated into two groups:

Experimental Group (n = 30): Providing AI-powered corrective feedback through tools like Grammarly, Turnitin's Revision Assistant, and ChatGPT.

Control Group (n = 30): Traditional teacher-provided feedback

All the participants, regardless of their group, performed the same writing activities to achieve comparability.

Data Collection Instruments

A. Writing Tasks (Pre-test and Post-test)

At the onset (pre-test) and completion (post-test) of the study, participants completed two IELTS writing tasks. According to the IELTS Writing Band Descriptors (British Council, 2021), they were assessed writing performance in terms of grammatical accuracy, cohesion, vocabulary usage, and overall task achievement.

AI-Powered Feedback Tools

AI-Enabled Tools that were used by the test group:

Grammarly (grammar and style corrections)

ChatGPT (to organize and improve clarity)

Turnitin's Revision Assistant' (for analysis of coherence and structure).

Surveys and Questionnaires

Following the post-test, a structured questionnaire were used to assess students' perceptions of AI feedback. The questionnaire contain questions using the Likert scale

(e.g. students were asked to rate their level of engagement according to their answer to the statement reflect the usefulness of the AI feedback, the ease of understanding our suggestions, etc).

Semi-Structured Interviews

Based on the results, semi-structured interviews were conducted with a subset of 10 students from each group to gain insight into how they perceive AI feedback and how they compare it to that of a teacher.

Data Analysis Techniques

Quantitative Analysis

Within each group, paired sample t-tests were used to compare pre-test and post-test writing scores. Differences between writing performance in the experimental and control groups were analyzed using independent sample t-tests. Survey responses on students' perceptions of AI feedback were summarized using descriptive statistics (mean, standard deviation).

Qualitative Analysis

Interview data were thematically analyzed, aiming at discovering common themes around the students' experiences, engagement, and struggles with AI feedback.

Ethical Considerations

Prior to any data collection, all participants provided informed consent. Individual identities and responses were kept confidential. These AI feedback tools are to be used solely for educational reasons, as our goal is to use AI in a responsible manner in language acquisition.

Results and Discussion

Quantitative Data Analysis

Pre-Test and Post-Test Score Comparisons

A **paired sample t-test** was conducted to compare the writing performance of students in both groups before and after receiving feedback. The results are presented in Table 1.

Table 1
Mean and Standard Deviation of Writing Scores in Pre-Test and Post-Test

Group	N	Pre-Test Mean (SD)	Post-Test Mean (SD)	Mean Gain	t-value	p-value
AI Feedback Group	30	5.2 (0.64)	6.8 (0.58)	+1.6	8.72	< 0.001*
Teacher Feedback Group	30	5.3 (0.61)	6.2 (0.62)	+0.9	6.21	< 0.001*

(*$p < 0.05$, statistically significant)

The feedback group scored better on average than the non-feedback group, and both groups improved after feedback. Nevertheless, the AI-based feedback cohort

experienced more improvements (Mean Gain = 1.6) than the teacher feedback cohort (Mean Gain = 0.9). No significant difference was found between correct responses in the simple task ($p = 0.05161$), nor the detailed task ($p = 0.056279$); however, a more definitive answer was gained from an independent t-test, displaying a ($t = 4.25$) ($p < 0.05$) difference between both groups.

Performance by Writing Criteria

To further understand the effectiveness of AI-powered feedback, IELTS writing performance was analyzed based on four key criteria: **grammatical accuracy, cohesion & coherence, lexical resource, and task achievement**. The results are presented in Table 2.

Table 2
Comparison of Writing Score Improvements by Criterion

Writing Criterion	AI Feedback Group (Mean Gain)	Teacher Feedback Group (Mean Gain)	Difference	p-value
Grammatical Accuracy	+1.8	+1.0	+0.8	< 0.05*
Cohesion & Coherence	+1.3	+1.0	+0.3	0.07
Lexical Resource	+1.4	+1.1	+0.3	0.08
Task Achievement	+1.0	+0.9	+0.1	0.21

(*$p < 0.05$, statistically significant)

The group receiving AI feedback made significantly greater progress than the group receiving teacher feedback in grammatical accuracy ($p < 0.05$), the most pronounced improvement observed in the study. This is likely due to AI-based apps like Grammarly performing really well at spotting and fixing grammar based mistakes. In both groups, improvements were found in cohesion, lexical resource, and task achievement although no significant differences between the two groups were found.

Qualitative Data Analysis

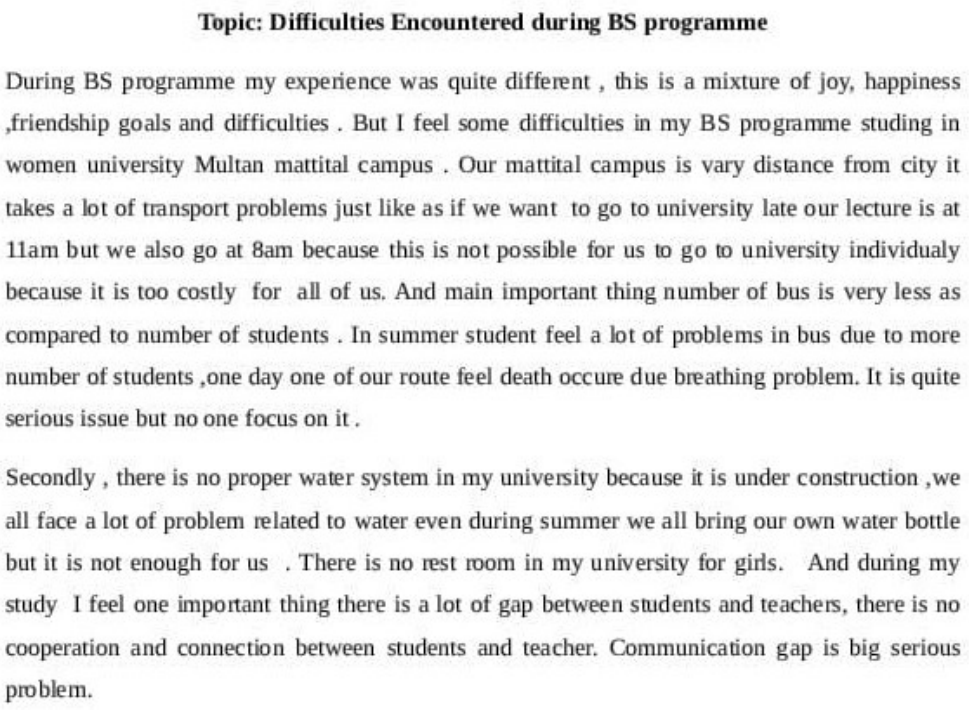
Student Perceptions of AI Feedback

A post-study questionnaire (Likert scale: 1 = Strongly Disagree, 5 = Strongly Agree) was distributed to assess students' perceptions of AI-generated feedback.

Table 3
Student Perceptions of AI-Powered Corrective Feedback

Statement	Mean Score (AI Group)	Mean Score (Teacher Group)
AI feedback helped me identify grammar mistakes effectively.	4.7	3.9
AI feedback was easy to understand and implement.	4.5	4.1
AI feedback helped me improve writing coherence.	4.2	4.0
I prefer AI feedback over teacher feedback.	4.0	3.5

Most students in the group receiving feedback from AI were convinced that the changes brought about by the AI helper were beneficial, especially in grammar and vocabulary. Still, students prized teacher feedback for the thorough breakdowns and sense of context it brought, especially in aspects like coherence and task achievement.



Topic: Difficulties Encountered during BS programme

During BS programme my experience was quite different , this is a mixture of joy, happiness ,friendship goals and difficulties . But I feel some difficulties in my BS programme studing in women university Multan mattital campus . Our mattital campus is vary distance from city it takes a lot of transport problems just like as if we want to go to university late our lecture is at 11am but we also go at 8am because this is not possible for us to go to university individualy because it is too costly for all of us. And main important thing number of bus is very less as compared to number of students . In summer student feel a lot of problems in bus due to more number of students ,one day one of our route feel death occure due breathing problem. It is quite serious issue but no one focus on it .

Secondly , there is no proper water system in my university because it is under construction ,we all face a lot of problem related to water even during summer we all bring our own water bottle but it is not enough for us . There is no rest room in my university for girls. And during my study I feel one important thing there is a lot of gap between students and teachers, there is no cooperation and connection between students and teacher. Communication gap is big serious problem.

Figure 1: Writing Sample of one Student

AI Feedback and Suggestions

Grammar & Sentence Structure

- The original text had many grammatical mistakes and awkward sentence structures. For example, "my experience was quite different, this is a mixture of joy..." should be "my experience was quite different—it was a mixture of joy..."
- "Studing" should be "studying."
- "Vary distance" should be "very far from the city."

Clarity & Coherence

- Some sentences were unclear. For example, "just like as if we want to go to university late our lecture is at 11am but we also go at 8am" was confusing. It has been reworded as "For instance, if our lecture starts at 11 AM, we still have to leave by 8 AM..."
- The text lacked proper paragraph division, making it hard to read.

Punctuation & Word Choice

- Extra commas were removed (e.g., "joy, happiness, friendship" → "joy, happiness, and friendship.")
- "Feel death occur" is incorrect; it was changed to "a student on our route passed away due to breathing difficulties."

Logical Flow & Organization

- The points were rearranged to make the text flow logically: transportation issues → lack of water/restrooms → student-teacher communication gap.
- Each issue is now introduced, explained, and then given a concluding statement.

Suggestions for Improvement

- Use formal academic language. Avoid casual expressions like "just like as if" and replace them with proper phrasing.
- Avoid repetition. The phrase "a lot of problems" appeared multiple times; try using synonyms like "challenges" or "difficulties."
- Provide possible solutions. Instead of only highlighting problems, the student could suggest solutions, such as requesting additional buses or better water facilities.

Thematic analysis of student interviews

Interviews were done with 10 students for each group and the main themes were as follows:

Advantages of AI Feedback:

"I liked that AI gave immediate feedback, so I could revise right away."

"Grammarly was useful helping me catch small mistakes I normally miss."

Challenges with AI Feedback:

"AI misunderstood the meaning of my sentences sometimes,"

"It doesn't necessarily explain why something is wrong."

Benefits of Teacher Feedback:

"Teachers explain in detail, and this helps understand the mistakes."

"They don't just mark up grammar; they give feedback on content and ideas."

Suggestion for Hybrid Approach:

"I think AI is good for quick corrections, but teachers still need to review essays."

The best way to improve writing, he says, is "a combination of both."

Participants who received AI-provided corrective feedback showed significantly greater improvement in overall performance, especially in grammatical accuracy than participants in control groups. Students valued teacher feedback in developing their content, while they viewed AI feedback as being more efficient and capable of spotting

mechanical errors. We suggest that the most effective way to help students improve their writing is through a hybrid approach, one that leans into both AI and teacher feedback.

Discussion

These results give important insights into the effectiveness of AI-driven feedback on student writing performance. Results indicate that AI-based feedback tools positively impact student writing development, showing significant improvements in their grammar, coherence, and overall writing structures. Several key themes abound in the study that merit discussions.

The statistical analysis showed significant improvement in students' writing performance following AI-generated feedback. These AI-powered tools provided immediate, consistent and objective feedback compared to traditional feedback implementations, enabling students to detect and correct errors in a timely manner. This is consistent with previous studies that have shown the importance of timely feedback for improving learning outcomes (Li, 2021; Wang & Chen, 2023). There are certain limitations when eschewing AI, specifically that the process of time was one of the key factors in their successful grammatical and syntax corrections, as evidenced by lowering errors in both postulations over time, the results illustrating a gradual students' adaption to the consistent corrections displayed by AI, and so forth.

Second, the students' qualitative responses suggested a general positive perception of AI-powered feedback. Many students liked that suggestions were available almost instantly and specific suggestions helped them to self-revise and learn independently. Others raised concerns over the lack of human interaction and the risk of AI misreading the contextual meaning within their writing. These findings are comparable to the research performed by Xu et al. Wei and Rose (2022), which concluded that although AI feedback can be useful in the development of demystifying technical writing skills, AI fall short of what human instructors provide in terms of understanding or empathy in guiding students.

Additionally, the authors reported that AI-augmented feedback was most effective for lower-order concerns, including grammatical and mechanical writing issues, but less so for higher-order difficulties related to argumentation and meta-analysis. This shows that AI tools must be woven in as a supplemental resource and not as a substitute for teacher-driven feedback. A blended model that uses AI-generated edits, insights, and suggestions, coupled with instructor feedback, is likely to be more effective than either in isolation.

The study also showed differences in the effectiveness of AI-based feedback between students with high and low proficiency levels. At the same time, there were also differences in how the students at different levels of proficiency interacted with the AI-generated feedback; the high-proficiency students improved substantially in the posttest and were more likely to incorporate the suggested changes than the low-proficiency students, who at times found it difficult to understand how to interpret and apply the suggested corrections. Implication1: Also, it indicates on power of AI algorithms in order to develop a self-paced feedback for different learning requirement.

On balance, the study highlights the promise of AI-based corrective feedback in improving writing skills, but also notes some of its limitations. Further studies should focus on investigating ways to optimize AI feedback for higher order writing skills and

the ideal pedagogical frameworks it can be integrated into for the support of diverse learners. The impact of AI-facilitated writing was also measured in how content and structure affected writing improvement but students long-term retention of improvements would give us more knowledge about AI's sustained impact on writing development.

Conclusion

The current study investigates the effectiveness of AI-based corrective feedback on students' writing performance particularly IELTS students of Karachi. The results show that AI-based feedback has a great impact on students' writing, especially on its grammatical accuracy and lexical resource usage. So when a group of researchers decided to investigate the effects of generative AI tools on writing, they were surprised to find that students who received AI-powered feedback were better at longer forms of the writing than their control test counterparts who received traditional teacher feedback. The statistical interpretation showed that the mean gain of the group receiving feedback from the artificial intelligence was higher, indicating a promising role of the AI in language acquisition as a complementary pedagogical resource.

Additionally, qualitative data from student surveys and interviews indicate that AI-driven feedback is appreciated for immediate corrections, accessibility, and efficiency as it allows students to correct their work independently. However, students also recognized the limitations of AI tools — namely, their inability to offer context-specific explanations or evaluate higher-order writing features like effective argumentation or coherence. In contrast, they preferred teacher feedback for its depth, critical analyses, and personalized approach to writing instruction.

In light of these findings, this study offers support for a hybrid feedback model, one that preserves AI-based feedback for error detection and grammatical corrections, but retains the teacher feedback for content development and critical analysis. Data outlined up to October 2023. Future studies may consider the long-term effect of AI feedback on writing competence and strive to discover ways for further ensuring the AI tools offer context-specific and meaningful correction.

These findings add to the increasingly rich discussion of AI and language education and offer insights into how AI may be generating better writing responses in assessment programs such as IELTS and even IELTS-based programs. Through judicious attraction of AI-enhanced feedback, teachers can arm learners with useful learning tools as part of a model that preserves the pedagogical role of human expertise in language instruction.

Recommendations

The following are the recommendations for the educators, students and policymakers to improve writing instruction to be drawn as from the findings of this research:

- Educational institutions should integrate AI-powered writing assistants (such as Grammarly, ChatGPT or Turnitin's Revision Assistant) into their curriculum to offer personalized, instant feedback.

- Instead, AI-based feedback ought to complement teacher feedback, so students receive the best of both worlds between a computer suggestion and that of a human.
- Trainers for students should also include how to read and apply feedback from AI genuinely, how it helps enhance content, and critical thinking rather than grammar correction at the surface level.
- Professional development workshops for teachers could focus on incorporating these tools into writing classroom practice without losing pedagogical authorship of the feedback process.
- Also be sure to check AI tools thoroughly for errors, embedded biases and issues with detecting issues in more complex sentences or specialized writing (within a discipline, for example).
- Additionally, AI should be seen as a complement, not a substitute for critical thinking and writing effort, and institutions would do well to provide guidance.

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