Proceedings of the 5th International Conference on Art, Design and Social Sciences
DOI: 10.54254/2753-7064/2026.34672

The Impact of Generative AI Feedback on Grammar Accuracy and Lexical Richness in L2 Writing

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Abstract. Nowadays, education and teaching assisted by generative artificial intelligence (AI) have become viral. The traditional feedback mechanism adopted in second-language academic writing is mainly the teacher's written corrective feedback (WCF). However, in recent years, AI feedback also provides diversified guidance for second-language writing. Therefore, some scholars have studied the impact of AI feedback on second-language academic writing. This article mainly conducts a systematic review of empirical research in this field. In view of the fact that grammatical accuracy and vocabulary richness in the process of second language writing are the core indicators for judging the quality of writing, and there are many research cases, this article mainly develops from these two dimensions to discuss the promoting role and mechanism of AI feedback. The study shows that AI feedback has significantly improved the language accuracy and vocabulary richness of second-language academic writing, mainly by reducing basic grammatical errors and using synonymous replacements for frequently used words in writing; however, it is also found that AI feedback has problems, such as a lack of context understanding and excessive modification. Therefore, it is still necessary to combine teacher feedback with AI feedback to help learners learn second-language academic writing.

Keywords: Generative AI, Grammar Accuracy, Lexical Richness, L2 Writing

1. Introduction

In recent years, generative artificial intelligence (AI) has made great breakthroughs. In second-language education and teaching activities, AI is no longer just an auxiliary teaching tool but an intelligent partner that can generate written feedback and provide personalized guidance. In the past, the research on second language writing mainly focused on teachers' feedback, which has problems of strong subjectivity, untimely feedback, and a large workload, which may affect the quality [1]. In contrast, AI relies on the algorithm advantages of the large language model (LLM) to reply with immediacy and fairness. The consistency of feedback quality can partially compensate for the limitations inherent in teachers' feedback to a certain extent. Therefore, in recent years, major empirical studies have begun to focus on differences between AI feedback and traditional teacher feedback in second-language writing, and to explore whether AI feedback can replace traditional written feedback. At present, a large number of studies have shown that AI feedback has had a certain impact on grammar accuracy and vocabulary improvement, but the number of discussions on

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DOI: 10.54254/2753-7064/2026.34672

the mechanisms, specific facilitative effects, and limitations of AI feedback remains limited, and the views are inconclusive.

This article will focus on the improvement of grammatical accuracy and vocabulary richness of AI feedback in second language writing. It mainly adopts the method of systematic review to analyze and summarize the achievements and existing research gaps in this field in recent years. The research in this article aims to provide reference and direction for future research and development of generative AI in the field of second language education and teaching, and to provide a practical basis for how front-line teachers can deeply integrate AI feedback tools in writing and teaching. It is committed to deeply integrating AI into students' learning and teachers' teaching work. The ultimate goal is that AI can be engaged in both the students' learning process and teachers' instructional practices.

2. Written corrective feedback (WCF)

2.1. Types and characteristics of written feedback comments

Written corrective feedback (WCF) refers to educators or other evaluators who have studied in a certain field to evaluate students' performance in learning, writing, behavior, and so on in written forms, with specific, constructive, and valuable replies. WCF can clearly point out the strengths and weaknesses of students, provide directions and paths for improvement, and enhance students' learning motivation and self-efficacy through different forms of positive feedback mechanisms, so as to stimulate students' inner learning motivation. In the past, a large number of empirical studies have proved that teachers' written feedback has a profound impact on second-language academic writing. Pearson pointed out that written feedback has multiple (and sometimes conflicting) effects, including analysis, response, interaction, and optimization of students' texts. Research shows that teachers' feedback tends to feature a series of specific and intentional comment characteristics reflecting their pedagogical stance, including the focus, manner, tone, syntactic structure, relevance, length, etc. The expression of the teacher's written feedback will greatly affect the student's modification. Therefore, Pearson summarizes 10 independent comment characteristics by summarizing years of empirical research, encompassing focus and goal, manner and tone, syntactic structure, textual relevance, location, clarity, length, use of mitigation strategy, presentation medium, and practicality, and provides feedback comments on second-language writing in the teaching field. It provides practical significance [2].

2.2. Application of AI feedback in second language writing

Because traditional teachers' feedback is sometimes difficult to provide personalized feedback for each student in a timely and targeted manner due to objective factors such as teachers' time and energy limitations, as well as subjective factors such as teacher-student relationship, students' cognition and ability level, and the feedback on the improvement of students' second language writing ability is also limited. Given this, under the influence of the popularity of AI tools in recent years, AI feedback will become an alternative way for traditional teacher feedback. Many studies have shown that AI feedback has significant advantages, such as immediacy, personalization, and multi-dimensional analysis, which can effectively solve the shortcomings of poor timeliness, weak targeting, and narrow coverage of teachers' feedback. Meanwhile, compared with traditional teacher feedback, AI feedback can improve the grammar and vocabulary level of second-language academic composition. Based on a powerful language processing model, AI tools can rapidly identify

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grammatical errors in students' writing, offer richer vocabulary replacement options, and enhance students' language expression [3]. Moreover, the study also points out that students demonstrate positive attitudes toward automatic feedback, which can effectively alleviate students' writing anxiety, promote students' deep thinking, and form a closed-loop chain of "emotion-cognition-behavior". In addition, behavioral participation is the most significant and direct factor in the effect of AI feedback, which can directly affect the improvement of students' writing skills by increasing students' interaction frequency [4].

3. Grammatical accuracy of AI feedback in second language writing

3.1. The role of AI feedback in promoting grammar accuracy

In second-language academic writing, the accuracy of grammar is the cornerstone of language expression, which directly affects the overall writing score. A large number of empirical studies have shown that AI feedback plays a significant role in the grammatical level of second-language academic writing. Muñoz had a quantitative study of 44 English majors in a public university in Chile, which aimed to compare the intervention effect of AI feedback and teacher feedback. Through an independent sample t-test, the research data shows that the AI feedback group significantly outperformed the teacher feedback group in terms of grammar range and accuracy ($p<0.05$). Participating students also said that AI tends to be superior in terms of error coverage and the comprehensiveness of error identification, and its correction of grammar and vocabulary is more accurate than that of teachers [5]. Chen conducted a similar study on 210 participants in a key university in eastern China, but the difference was that the study mainly analyzed qualitative data and collected students' reflective journals, classroom performance, and student texts. The experimenter did not have clear restrictions on the AI tools used by students, with the purpose of observing students' preferences for AI, interaction, and performance in use. Through text data statistics, 84% of students perceived that AI tools are effective in grammar, spelling, punctuation, redundancy, and Chinese English (Chinglish) and other common language problems, as well as improving the level of English writing [6]. However, it is worth noting that this study mainly focuses on the subjective perception level of students, and the correspondence between it and the improvement of actual language ability needs to be further verified through objective measurement. Another scholar, Ahmadi, carried out an in-depth semi-structured interview with 20 English learners from a freshman year in an Iranian university with qualitative research as the orientation. The results also show that AI feedback can improve students' grammar awareness, which mainly includes frequent errors such as tense, subject, and predicate consistency, subordinate clauses, punctuation, and so on in second-language writing. The interviewed students generally said that AI not only acts as a correction tool, but also improves their self-awareness, which can help them better understand complex grammar, thus improving their self-confidence in second-language writing. Through the summary of past research, the main difference between AI feedback and teacher feedback in terms of grammatical accuracy is that the grammatical errors pointed out by AI feedback are often more comprehensive. In cases where certain errors are not addressed in the teacher feedback or are pointed out but are still unclear to students, AI feedback tends to offer more detailed and personalized explanations. AI feedback tends to provide more detailed and personalized explanations, which is helpful for students to truly master grammar rules [7].

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3.2. Mechanism of action

At present, the mechanism of AI feedback on second-language academic writing is mainly concentrated on the cognitive and behavioral levels. For the cognitive level, AI feedback is more detailed than teacher feedback, which is more helpful for students to understand their own grammatical errors in writing. Through sustained error correction and accumulation, this process can help students genuinely internalize their grammatical knowledge. At the behavioral level, AI feedback is more personalized and immediate. Unlike the extended turnaround time of teacher feedback, students can respond to AI feedback promptly and can ask AI questions at any time, thus effectively improving the frequency of interaction between students and AI. Among them, Mekheimer conducted experiments with 96 EFL college students in a key university in eastern China. Through correlation analysis, it was found that the frequency of AI use was significantly positively correlated with the frequency of students' modification and writing quality ($p<0.05$), that is, the more times students modify, the more obvious their overall improvement effect in second language writing [8]. This discovery provides strong support from the behavioral level: AI feedback promotes the improvement of writing quality by improving the explicit behavior indicator of modification frequency, making high-frequency interactive behavior an important mediating mechanism between AI feedback input and writing output. At the same time, a large number of studies have pointed out that this high-frequency interaction can not only improve students' concentration but also effectively alleviate writing anxiety and enhance students' self-confidence and sense of accomplishment, thus having a positive emotional support effect on the writing process.

3.3. Limitations of existence

Although the feedback provided by AI at the grammar level has shown good results, AI still has many shortcomings in terms of its own feedback quality and students' writing improvement. First of all, AI feedback is more accurate in dealing with superficial grammatical errors (such as grammar problems, such as spelling, punctuation, articles, prepositions, etc., as well as simple tense problems), but sometimes semantic misjudgement or excessive error correction occurs for deep, complex syntactic structures, discourse context, and rhetorical intentions [8]. For example, a complex sentence with the original correct context is judged as a grammatical error and changed to other sentence patterns with the same semantics; sometimes, it is recommended to modify it when the semantics are acceptable, resulting in excessive error correction. Research shows that the quality of AI feedback often depends on the prompts provided by students. If the prompts are vague, it will affect the quality of feedback [6]. At the same time, it is also found that there are hidden concerns about the authenticity of the explanation provided by AI feedback. The so-called "hallucination" phenomenon may occur when the large language model generates an interpretation. It provides a seemingly reasonable but not actually accurate grammatical rule interpretation. Because students usually lack enough meta-language knowledge to independently verify the feedback content, this problem may lead to the construction of misconceptions and have a negative impact on the long-term development of students' grammar ability. In terms of students' acceptance, students generally reflect that they are worried about over-reliance on AI feedback and a lack of their own thinking. This passive acceptance and dependence will also reduce students' own writing ability, which is not conducive to students developing the habit of critical thinking.

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4. Vocabulary richness of AI feedback in second language writing

4.1. The role of AI feedback in promoting vocabulary richness

Compared with grammar, the improvement of vocabulary is a relatively slow process, involving the transformation from receptive knowledge to output knowledge [9]. Vocabulary richness is a multi-dimensional concept. At present, the generally accepted vocabulary dimensions are diversity, complexity, density, and uniqueness. As for whether WCF can improve the vocabulary richness of second language writing, the current empirical research is limited, and the results are varied. Through the study of 65 middle and low-level college students, Ji pointed out that AI did not have a significant impact on the richness of students' vocabulary, and attributed the reason to the slowness of the second-language vocabulary acquisition process itself, indicating that students require more vocabulary accumulation, deeper semantic understanding, and long-term training to improve the lexical proficiency in second-language writing [10]. Sung analyzed a large number of available data sets in the International Corpus Network of Asian Learners of English (ICNALE) project through corpus analysis and research. By virtue of the advantages of the large language model in semantic understanding and vocabulary generation, AI feedback can provide learners with replaceable advanced vocabulary and context suggestions, effectively improving the richness of vocabulary [11]. Xie conducted a one-semester (16-week) study on 60 freshmen majoring in English from a key university in eastern China. The experimental results also show that AI feedback is more effective in the diversity and complexity of vocabulary in second-language writing. AI feedback can provide students with personalized vocabulary advice according to the learner's second language writing level and context, including a large number of synonymous replacement words and corresponding instructions for use. Students also indirectly broaden their vocabulary in the process of consulting these words. In comparison, teacher feedback only offers general vocabulary-level advice, which may restrict learners' opportunities for autonomous lexical exploration. However, it is worth noting that both AI feedback and teacher feedback show a trend of improving students' vocabulary from fast to slow, but it still shows the effect of promotion in general. This conclusion is in line with the development mechanism of second-language vocabulary acquisition [12].

4.2. Mechanism of action

At present, the main strategy adopted by AI feedback to improve the richness of students' second-language writing vocabulary is mainly based on the attention hypothesis proposed by Schimids and the output hypothesis theory of Swain. The former means that learners must discover language characteristics before acquisition can begin; the latter points out that comprehensible output can provide learning opportunities for second language learners. If these two theories are applied in the second language writing mechanism, through AI feedback, students can focus on the vocabulary they use in writing. AI will provide relevant error analysis, identifying problems such as spelling errors, contextually inappropriate word choices, and repeated or mismatched collocations. The feedback and explanations provided by AI can further guide learners to consult relevant synonyms and their contextual usage. In the process of consulting words and making context modifications, learners not only expand their own vocabulary, but also expand the breadth of their understanding of vocabulary, such as the remote meaning of synonyms, pragmatics, and vocabulary collocation, so as to promote the transformation of vocabulary knowledge from the acceptance dimension to the output dimension. In the study of Xie, this point is also pointed out. Through experimental demonstration, AI feedback can effectively attract students' attention to vocabulary. At the same

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time, it compares AI feedback with teachers' feedback, finding that its anonymous and non-evaluative characteristics can alleviate students' writing anxiety to some extent. Then, students are more willing to try advanced vocabulary to achieve the effect of improving the richness of writing vocabulary [12].

4.3. Limitations of existence

Although current research generally proves that AI feedback can improve students' vocabulary richness, there are still many limitations to the vocabulary optimization suggestions provided by AI in second language writing. First of all, AI feedback pays more attention to synonym replacement and the use of advanced words in vocabulary optimization, but pays less attention to the adaptability and accuracy of vocabulary selection, such as improving the vocabulary complexity of the article. As a result, the article tends to be long and clumsy [8]. Secondly, the feedback of AI on vocabulary richness has a different impact on learners at different levels. In the writing of low-level learners, there are often explicit problems such as spelling errors, punctuation misuse, and vocabulary poverty. Such errors exhibit clear regularities and can thus be more accurately identified and processed by an AI language analysis model, so the feedback effect of AI in such groups of learners is more accurate and effective. For high-level learners, they have the mature ability in dealing with words, and the need for deep content logic and chapter structure optimization is more prominent. However, AI still lacks the ability to deeply understand the author's intent and the grammatical context. In the vocabulary feedback, sometimes the original context-fitting expression is replaced with more difficult words, resulting in excessive modification, which destroys the naturalness of the article and the author's style [12]. At present, the research on AI feedback on vocabulary richness in second language writing remains in its early stages, and there are a lot of gaps. Therefore, at present, it can only show that AI feedback is effective in improving the writing level in the short term, and it is not certain whether the long-term improvement can have an impact.

5. Discussion

Current research shows that AI feedback has a significant effect on the grammar and vocabulary diversity of second language writing. The main advantage is that the immediacy and personalization of the feedback can provide students with clearer answers, which is convenient for students to understand grammar and vocabulary errors in writing. At the same time, AI can alleviate students' writing anxiety to a certain extent, stimulate students to further learn and improve, and encourage students to use alternative expressions. In terms of the feedback mechanism, AI mainly adopts the method of combining behavior and cognitive mechanisms. By increasing the frequency of interaction, students can gradually enhance their cognition of grammar points and vocabulary in the process of making multiple modifications based on feedback. At the same time, the theory of the attention hypothesis and output hypothesis can also prove this mechanism, which can stimulate students to notice the problems in writing and respond. However, AI feedback still has a lot of shortcomings in grammar and vocabulary. First of all, the adaptability of AI feedback to different levels of people is more accurate and effective for low-level students, mainly focusing on the correction of grammatical errors, vocabulary, spelling, and collocation errors on the surface level. But for advanced students, the grammar and vocabulary feedback provided by AI is limited. Secondly, AI feedback is sometimes prone to overcorrection and misjudgement, exhibits insufficient sensitivity to textual context, and may prioritize lexical complexity over overall writing quality.

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Meanwhile, the AI feedback on the research about second language writing is still limited, and there are research gaps, especially in the vocabulary dimension.

Based on the above discussion, the future second-language writing teaching can explore the construction of a hierarchical feedback model of "AI preliminary evaluation -students' self-revision - teachers' refined evaluation". Specifically, low-proficiency learners can first use AI feedback to independently modify superficial grammar and vocabulary errors, and then the teacher will provide targeted feedback on the text structure and content depth; for high-level learners, it is appropriate to focus on teachers' pragmatic and critical feedback, and use AI tools as auxiliary references, so as to fully leverage the strengths of both resources. The advantages of the two types of feedback methods complement each other and improve the overall feedback efficiency and quality, which can not only reduce the correction tasks of teachers and improve the feedback time limit, but also improve the quality of feedback, which is conducive to the improvement of students' second-language writing skills. On the basis of academic research, more long-term research can be carried out in the future, and the improvement effect of AI feedback on different dimensions of vocabulary can be refined to address the current research gap.

6. Conclusion

This article discusses the impact of generative AI feedback on the grammatical accuracy and vocabulary richness of second-language writing, and states the promoting role, mechanism, and limitations of AI feedback on writing with regard to grammatical accuracy and vocabulary richness. Through a systematic review of the empirical research in recent years, this study finds that AI feedback can effectively improve the grammatical accuracy and vocabulary richness of second-language writing. The main mechanism of action is to relieve students' writing pressure through anonymity and non-evaluation characteristics, and then encourage students to actively explore feedback.

In addition, through interaction, the AI interaction process and the frequency of interaction with students can effectively help students improve their understanding of grammar rules and the pragmatics and collocation of vocabulary, further stimulate students' self-confidence, and thus improve their writing level. Besides, there are still problems such as excessive modification and a lack of context understanding in AI feedback. In view of this, in future teaching, AI still cannot completely replace teachers' feedback, but the hybrid feedback model, which combines AI and teachers, can help make up for their respective shortcomings and further improve students' enthusiasm and ability to write a second language.

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