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AI-Based Feedback Systems for Improving Grammar Accuracy: An Experimental Study in EFL Context

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ABSTRACT

This study aims to investigate the effectiveness of Artificial Intelligence (AI)-based feedback in improving the grammatical accuracy of English as a Foreign Language (EFL) learners. The study employed a quantitative quasi-experimental design using a pre-test-post-test control group. The participants consisted of 60 university students, who were divided into an experimental group receiving AI-based feedback and a control group receiving conventional teacher feedback. Data were collected through essay writing tests and analyzed using descriptive statistics, paired-sample t-tests, and independent-sample t-tests. The findings revealed that both groups demonstrated improvement; however, the experimental group showed a significantly greater increase in grammatical accuracy (from 65.4 to 82.6) compared to the control group (from 66.1 to 74.3). The results of the independent-sample t-test indicated a statistically significant difference between the two groups ($p < 0.001$). These findings suggest that AI-based feedback provides immediate and individualized corrective input that effectively enhances learners' grammatical performance. Nevertheless, teacher feedback remains essential in providing contextual and pedagogical support. Therefore, the integration of AI and teacher feedback is recommended to achieve optimal learning outcomes in EFL writing.

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1. INTRODUCTION

Grammatical errors in oral and written communication are one of the biggest obstacles for students in achieving optimal communicative competence [1], [2]. Furthermore, these difficulties are often exacerbated by the limited feedback provided by instructors in language learning. Therefore, AI-based feedback systems offer a new solution that can provide instant, specific, and adaptive corrections tailored to each student's learning needs [3].

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AI-based feedback systems have been widely used in various learning contexts, including EFL learning. These technologies, such as those developed by Grammarly, ChatGPT, and Cambridge's Write & Improve, are capable of providing fast and effective feedback. Research by [4] showed that using a combination of human feedback and AI-based systems had a positive impact on EFL students' writing skills by accelerating the process of understanding grammatical errors. Similarly, research by [5], [6] in Iran revealed that students who used AI feedback were able to identify their error patterns more quickly, allowing them to improve their sentence structure more efficiently.

In Indonesia, although this technology is gaining attention, qualitative research examining students' experiences and perceptions of the use of AI in EFL learning remains very limited. Several studies, such as those conducted by [7], have demonstrated the effectiveness of AI in quantitatively improving students' grammatical accuracy. However, there is little research exploring the interactive experiences between students and AI systems. This qualitative research is crucial for understanding how students utilize AI systems in their learning and how these interactions influence their understanding of grammar.

Furthermore, it is important to consider the social and cognitive dimensions that arise from the use of this technology. [8] revealed that interacting with AI can increase students' learning autonomy and metacognitive awareness of their grammatical errors [9], [10]. This suggests that AI not only serves as an efficient learning tool but also helps students become more aware of their learning process. However, several other studies, such as those by [11], highlight AI's limitations in understanding cultural contexts and linguistic nuances that are often better understood by human instructors [12]. Therefore, while AI is capable of providing accurate corrections, understanding the social and cultural contexts in language learning remains a challenge.

In the context of EFL learning in Indonesia, there are varying views on the use of AI. Some students feel motivated by the rapid and personalized feedback provided by AI systems, while others express difficulty understanding technical explanations that sometimes feel too rigid and decontextualized [13]. This study aims to explore in more depth how students' experiences and perceptions of interacting with AI systems influence their grammar learning. By examining these aspects, it is hoped that new insights can be found into better ways to integrate AI into EFL learning effectively.

Research by [14] also highlighted the successful use of ChatGPT in grammar practice, which increased EFL students' engagement. However, concerns about the accuracy of the information provided by the system remain a topic of concern [15], [16]. As the use of AI continues to expand, it is important to consider not only how effective these systems are in improving grammar skills but also how students experience them in their daily learning practices. Therefore, this study will focus on the qualitative aspect, delving deeper into students' experiences using AI-based feedback [17].

This study aims to explore the effectiveness of an AI-based feedback system in improving grammatical accuracy in EFL learners, using a qualitative approach. The main focus of this study is to explore students' experiences and perceptions of their interactions with the AI system during the learning process. Furthermore, this study will analyze how

the feedback provided by the AI system is internalized by students in their language practice, both in written and spoken communication.

Theoretically, this research is expected to enrich the existing literature on technology-mediated language learning, particularly in the EFL context. This research will provide a better understanding of the potential and challenges of using AI technology in language learning, as well as provide new insights for technology developers and educators to optimize the use of AI in EFL classrooms. Practically, this research can also provide recommendations for teachers, application developers, and educational institutions to more effectively integrate AI technology into English learning, while still considering the existing social and pedagogical dimensions.

2. METHOD

This study used a quantitative approach with a quasi-experimental design employing a pre-test–post-test control group format to examine the effect of an Artificial Intelligence (AI)-based feedback system on the grammatical accuracy of English as a Foreign Language (EFL) learners. The quasi-experimental design was selected due to the researcher's inability to randomly assign individual participants, so intact classes were utilized as research groups without interfering with the ongoing instructional process. The study was conducted in the English Language Education Study Program at a university in Indonesia during the even semester of the current academic year, involving 60 EFL students selected through purposive sampling based on two main criteria: enrollment in an English writing course and relatively homogeneous English proficiency as indicated by previous academic performance. The participants were divided into two groups, consisting of 30 students in the experimental group who received AI-based feedback and 30 students in the control group who received conventional lecturer-based feedback, with initial equivalence ensured through pre-test results [18].

The main instrument used in this study was an English essay writing test administered as both a pre-test and post-test, designed to measure grammatical accuracy across several components, including tense usage, subject-verb agreement, article usage, prepositions, and sentence structure. The research procedure began with a pre-test in which all participants wrote an English essay to establish baseline grammatical accuracy. This was followed by a four-week treatment period, during which the experimental group received automated corrective feedback and suggestions through an AI-based system, while the control group received traditional written feedback directly from the lecturer without AI assistance. After the treatment period, a post-test with an equivalent level of difficulty to the pre-test was administered to both groups to assess improvements in grammatical accuracy [19].

Data analysis was conducted using SPSS version 26. Descriptive statistics were first applied to determine the mean scores and standard deviations of both pre-test and post-test results. Subsequently, a paired-sample t-test was used to measure within-group improvements, while an independent-sample t-test was employed to compare the differences in performance gains between the experimental and control groups. In addition, effect size analysis using Cohen's d was performed to determine the magnitude of the

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influence of the AI-based feedback system on students' grammatical accuracy. The population of this study consisted of EFL students in the eighth semester [20].

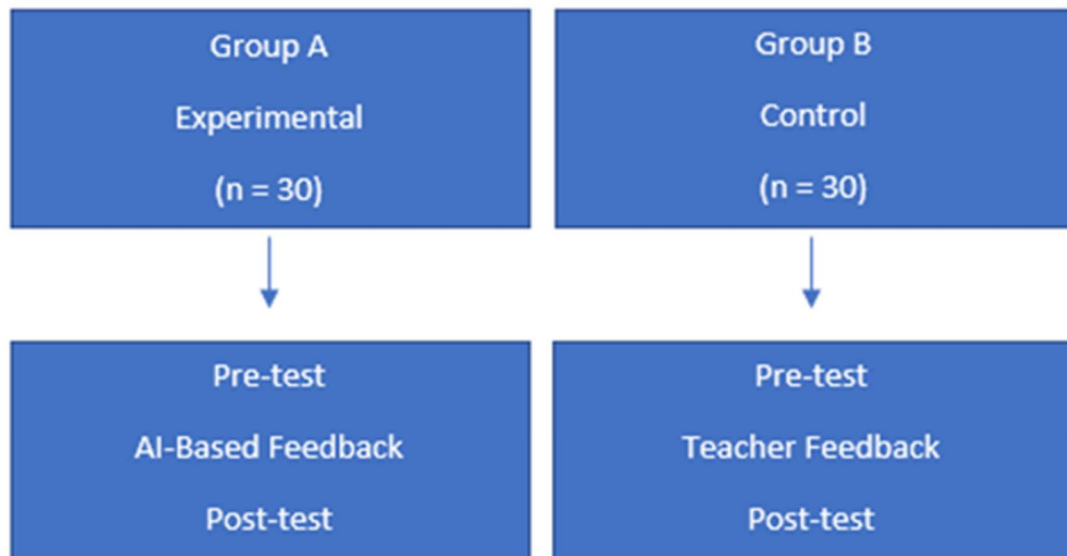


Figure 1. Quasi-Experimental Design with Pre-test and Post-test Control Group

3. RESULTS AND DISCUSSION

3.1. Results

Data analysis was conducted by comparing pre-test and post-test scores on students' grammatical accuracy between the experimental and control groups. A total of 60 students participated, with 30 assigned to the experimental group and 30 to the control group.

Descriptive Statistics

The following table presents the means and standard deviations of the pre-test and post-test scores for both groups:

Table 1. Descriptive Statistics Results			
	Pre-Test	Post-Test	Range
Experimental Group (AI)	65,4	82,6	17,2
Control (Manual)	66,1	74,3	8,2

Descriptive results showed that both groups experienced an increase in grammar scores, but the experimental group showed a greater increase compared to the control group.

Table 2. Independent sample test results (post-test)			
	S	df	Score
Post-test (Experimental vs Control)	4.21	58	0.0001

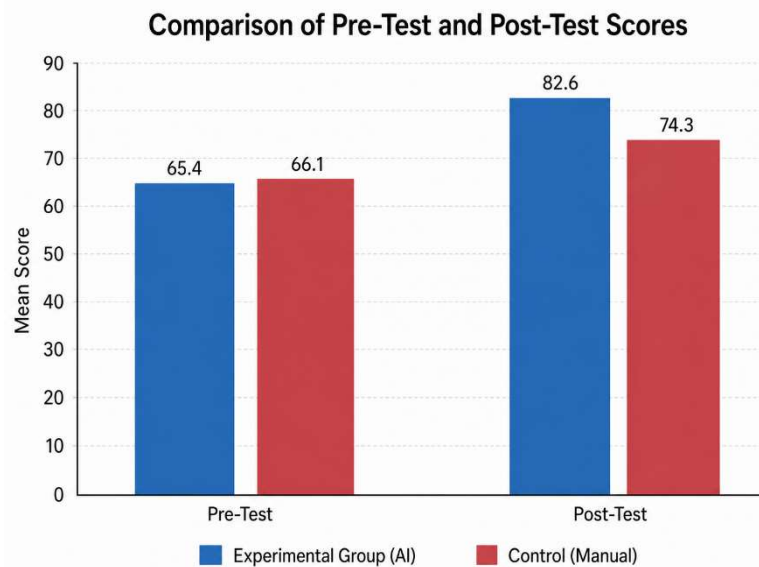


Figure 2. Comparison of Pre-test and Post-test Scores

Descriptive analysis showed that both the experimental and control groups experienced improvements in their grammatical writing skills after going through several stages. In the pre-test phase, the average score for the experimental group was 65.2, while the average score for the control group was 64.7, indicating that both groups had relatively equal initial abilities.

After the intervention, post-test results showed a significant difference. The experimental group, which received AI-based automated feedback, achieved an average score of 78.6, while the control group, which received manual feedback from the instructor, only achieved an average score of 71.4. Thus, the experimental group's score increased by 13.4 points, compared to only 6.7 points in the control group.

An independent samples t-test was conducted to compare the post-test results between the two groups. The analysis revealed a statistically significant difference ($S=4.21$), indicating that AI-based automated feedback had a stronger positive effect on students' grammatical accuracy compared to conventional instructor feedback.

These findings support the research hypothesis that the application of AI technology as a source of written feedback is more effective in improving students' grammatical accuracy than traditional feedback approaches.

3.2. Discussion

The findings of this study showed a significant improvement in students' grammatical accuracy in the experimental group receiving AI-based feedback, compared to the control group receiving conventional teacher feedback. The paired-sample t-test results revealed that the experimental group achieved a higher mean post-test score of 82.6 than the control group (74.3) with a significance level of $p < 0.001$.

This suggests that AI-based tools like Grammarly or GPT-based grammar checkers can improve grammatical accuracy in EFL students' writing in a relatively short period of time (six weeks).

These findings align with previous studies highlighting the potential of AI-based automated feedback in teaching second language writing [21], [22]. The observed improvements also corroborate the findings of [23], who highlighted that timely, immediate, and individualized feedback enhances learners' ability to notice linguistic errors and supports long-term language acquisition. Unlike conventional feedback, which often suffers from delays, AI-based feedback provides instant, detailed, and iterative corrections, enabling learners to engage more actively in self-editing.

However, the results of this study also underscore the importance of ongoing teacher feedback. Although the control group achieved lower improvement scores (8.2 points), students still benefited from teacher comments that provided contextual explanations and pedagogical support. This is consistent with [24] argument that teacher feedback not only provides linguistic correction but also offers affective support that motivates students [25]. However, AI feedback is superior in efficiency and coverage; it cannot completely replace the motivational and interpretive functions of teacher feedback.

4. CONCLUSION

This study confirms that artificial intelligence (AI)-based feedback has a significant impact on improving EFL students' grammatical accuracy. Students who received automated feedback from AI systems like Grammarly or GPT-based grammar checkers achieved higher post-intervention scores than those who only received manual feedback. These findings suggest that AI is not only a corrective tool but also a learning strategy.

Effective pedagogy in teaching academic writing. Theoretically, the results of this study extend the existing literature on technology-enhanced language learning (TELL), particularly within the framework of second language acquisition (SLA), by emphasizing the importance of immediate, consistent, and repeated corrective feedback in strengthening students' linguistic awareness. Practically, this study has implications for teachers and higher education institutions: integrating AI-based tools can reduce teachers' correction workload while encouraging students' autonomy in the revision process. However, this study has limitations, including a relatively small sample size, a short intervention period, and a brief study that was focused on a single genre of academic writing. Therefore, future research is recommended to involve a more diverse population, extend the duration of the intervention, and explore different writing genres. Further investigation should also examine the affective dimension, student perceptions, and the effectiveness of hybrid feedback models that combine the power of AI with the pedagogical role of teachers.

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