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Optimizing Artificial Intelligence Tools for English Grammar Teaching: A Multidimensional Approach

Huang Kui, Chen Minrong, Wu Caixia, Cao Xue*

Guangdong University of Science and Technology, Guangdong, China

**corresponding author*

Abstract: This study aims to explore the multidimensional factors that affect the effectiveness of artificial intelligence (AI) tools in college students' English grammar learning. It provides a comprehensive analysis of how individual differences, tool design, instructional integration, and contextual environment impact learning outcomes. Through a systematic review and comparison of relevant domestic and international literature, the study finds that learners' learning styles, the adaptivity of AI tools, and the quality of integration between teaching and technology are key factors influencing tool effectiveness. Based on these analyses, this study proposes optimization pathways for the application of AI tools, including improving tool design, strengthening teacher training, and enhancing cross-cultural adaptability, with the aim of providing theoretical support and directions for future practice in AI-assisted grammar teaching.

Keywords: Artificial Intelligence; English Grammar Instruction; College English; Motivation to Learn; Technology Acceptance; Optimization Approach.

1. Introduction

With globalization, English has become a vital language for academic, professional, and social communication. As a core part of language learning, English grammar poses a significant challenge for university students. Traditional grammar teaching methods, while helpful, often fail to address individual learner differences, offer personalized feedback, or adjust to diverse learning needs. This limitation has sparked increased interest in exploring more effective and adaptable approaches for teaching grammar (Kim, 2019).

In recent years, artificial intelligence (AI) technologies have become more widely incorporated into educational applications. ing Providing new ways to improve instruction in English grammar. AI tools like grammar checkers and conversational assistants have become potential solutions to enhance grammar teaching through real-time feedback and personalized learning experiences. However, despite their promising potential, several challenges persist, especially in their capacity to handle complex grammatical analysis and adapt to various cultural contexts. These limitations have slowed the widespread adoption and effectiveness of AI tools in the classroom (Mudhsh et al., 2025).

While existing studies highlight the benefits of AI tools in enhancing grammar teaching outcomes, they often overlook the complex factors that influence their success. The current research primarily focuses on the technical features of AI tools or their effectiveness in specific educational settings, without thoroughly exploring how individual differences, tool design, and instructional integration together affect learning outcomes. Additionally, there is a lack of comprehensive research on the cross-cultural adaptability of these tools, which limits their usefulness across diverse educational environments (Park, 2019).

This study aims to fill these gaps by conducting a systematic review of factors affecting the effectiveness of AI tools for English grammar learning. By analyzing existing domestic and international research, this paper seeks to identify key factors influencing tool effectiveness and suggest pathways for optimizing AI tool design, instructional integration, and cross-cultural adaptability. Through these insights, the study offers theoretical support for the future implementation of AI tools in English grammar teaching and provides practical recommendations for overcoming existing challenges.

2. State of Domestic and International

Research

2.1 International Research: Focused on AI Tool Effectiveness

International research on the application of AI in education has predominantly focused on assessing the effectiveness of AI tools in improving learning outcomes, particularly in language teaching. The central theme in much of this research is the deep adaptation between AI tools and individual learners. Studies emphasize that AI can be tailored to meet learners' diverse needs by offering personalized feedback and support. For example, Kim (2019) conducted a controlled 16-week experiment on the use of AI chatbots for grammar teaching, revealing that students using AI tools saw an average improvement of 27% in their grammar scores compared to traditional human tutoring. Mudhsh et al. (2025) found that using an AI tool positively affected learner attitudes and engagement, resulting in a 35% increase in student motivation in Oman; however, the sample size of 92 students limited the generalizability of the results.

Despite these promising findings, international research also reveals several limitations. One key issue is the lack of cross-cultural adaptation. Many studies do not account for differences in how students from diverse cultural backgrounds learn grammar, thereby limiting the applicability of AI tools across varied educational contexts (Park, 2019). Additionally, there are concerns about AI tools' ability to handle complex grammar structures, particularly in languages with intricate sentence structures (e.g., nested clauses and verb tenses). The limitations of these tools in such areas undermine their effectiveness, a challenge that remains significant in AI-enhanced grammar instruction.

2.2 Domestic Research: Emphasizing Local Challenges and Responses

In contrast to the focus of international research, domestic studies have been more concerned with addressing the practical challenges and limitations faced by AI tools in local educational settings. One of the major concerns in China is the lack of personalized feedback and the limited adaptability of AI tools to students' diverse learning needs. Domestic scholars such as Liu (2025) emphasized that teachers' technical competence and ability to integrate AI into the classroom are crucial to the effective use of AI tools. Liu (2023) also noted that many AI tools still struggle to handle Chinese learners' unique grammatical challenges, such as word-order issues in sentence construction and the use of tones.

Furthermore, domestic research emphasizes the importance of a well-designed educational environment that encourages the integration of AI tools into everyday teaching practices. Zhou (2023) highlighted the need for systematic teacher training and for developing teaching processes that smoothly incorporate AI tools to improve instructional effectiveness. Additionally, scholars such as Xue (2025) argued that many AI tools used in Chinese classrooms still encounter issues, including slow feedback response times and limited student engagement, which prevent them from reaching their full potential in grammar instruction. Consequently, domestic research calls for adopting more comprehensive technological integration strategies and placing a stronger emphasis on tailoring tools to local educational needs.

2.3 Gaps and Opportunities: Filling the Gap in Existing Research

While both international and domestic studies have contributed valuable insights into the role of AI in grammar teaching, several gaps still exist in the current research. First, there is a notable lack of cross-cultural studies exploring how AI tools can be tailored to meet the specific grammatical learning needs of students from different cultural and linguistic backgrounds. As mentioned earlier, international studies often fail to account for cultural differences, which limits the broader applicability of AI tools across diverse classrooms. Domestic research, while focused on local challenges, tends to emphasize technical issues such as feedback speed and teacher training, with less attention to the broader educational system and the cross-cultural integration of AI tools.

Second, the challenge of addressing complex grammar structures has been largely overlooked in both international and domestic research. Although AI tools have proven effective in improving basic grammar skills, their ability to handle more complicated language features, such as intricate sentence structures, remains underexplored. The current literature does not sufficiently examine strategies to optimize these tools for advanced learning needs.

This study aims to fill these gaps by providing a thorough review of both domestic and international research, highlighting the interaction between individual differences, tool design, and instructional integration. It also suggests ways to improve, including cross-cultural adaptation, better AI tool performance for complex grammar analysis, and smooth integration of AI tools into everyday teaching practices, contributing both theoretical and practical insights to the field.

3. Factors Affecting AI Tool Effectiveness

3.1 Individual Factors

Research shows that individual learner characteristics significantly influence the effectiveness of AI tools in grammar learning. Important personal factors include learners' acceptance of technology, cognitive styles, and motivation. Field-independent learners, who are better at processing information on their own, are more capable of engaging with AI tools, as these tools often require some independence in learning. Along with cognitive styles, learners' motivation is another vital factor. Therefore, AI tools that aim to boost intrinsic motivation through engaging interfaces and personalized feedback can significantly improve learning results.

3.2 Technological Factors

The technological aspects of AI tools are crucial in determining their effectiveness in grammar teaching. Key factors include the AI tool's adaptability, its ability to handle complex grammatical structures, and the quality of the feedback it provides. Liu (2023) highlighted that AI tools capable of generating personalized exercises and adapting to learners' proficiency levels lead to more effective grammar learning. Tools that offer adaptive feedback, adjusting task difficulty based on the learner's progress, have been shown to improve learning outcomes by maintaining an appropriate level of challenge. However, despite these advancements, AI tools still struggle to manage complex grammatical structures. For example, Park (2019) pointed out that while AI tools are effective at correcting basic grammar errors, they struggle with more advanced sentence constructions, such as nested clauses or mixed tenses. AI's limited ability to accurately assess and correct complex grammar patterns reduces the effectiveness of these tools in teaching advanced grammar.

Furthermore, the quality of feedback from AI tools is essential. Multimodal feedback, which combines text, audio, and visual cues, has been shown to improve learners' understanding and retention (Chen Ming et al., 2024). AI tools that deliver timely, personalized feedback can help learners address their grammar gaps more effectively, leading to better performance over time.

3.3 Situational Factors

Situational factors, especially teacher training and AI tool integration in the classroom, are crucial for maximizing AI's effectiveness in grammar instruction. Teacher training is vital because instructors usually decide how and when to use AI tools in their teaching methods. According to Liu (2025), the effectiveness of AI tools is closely tied to the teacher's ability to integrate technology into their instructional strategies. Teachers who are well-trained in using AI tools can better guide students in their interactions with these tools, ensuring that the technology supports their learning rather than becoming a distraction.

Additionally, teachers need to have the skills to adapt the AI tool to their specific teaching environment. Zhou (2023) pointed out that teachers' ability to effectively incorporate AI tools into classroom activities, such as lesson planning and assessment, greatly influences the success of the tool. For instance, a teacher who knows how to use AI tools to evaluate students' grammar errors in real time and provide personalized feedback can help students improve their grammar skills more efficiently.

The classroom environment also plays a crucial role. Wu et al. (2024) found that when AI tools are integrated into an instructional design that aligns with the curriculum, their effectiveness is maximized. A well-designed curriculum that seamlessly incorporates AI tools enables continuous learning, allowing students to practice grammar skills both inside and outside the classroom. Conversely, if AI tools are used in isolation or without proper integration into the classroom workflow, their potential to improve grammar learning is significantly reduced.

Furthermore, the institutional environment, including access to technology and support for teachers, also affects the effectiveness of AI tools. Schools that invest in technology

infrastructure and offer ongoing professional development for teachers are more likely to experience positive results from integrating AI tools. As Liu (2025) observed, a supportive environment—such as reliable access to devices and strong technical support—is crucial for the successful use of AI tools in grammar teaching.

4. Multidimensional Optimization Pathways

4.1 Technical System Optimization

The effectiveness of AI tools in teaching grammar largely depends on their technical capabilities, especially in handling complex structures and providing personalized feedback. Currently, AI tools are limited in their ability to analyze and correct advanced grammatical forms, such as nested clauses and mixed tenses (Park, 2019). Therefore, the main goal is to improve the accuracy of grammar analysis tools to over 85% so that they can handle a wider variety of grammatical complexities.

Furthermore, AI tools should offer more adaptive feedback. They can be improved to create personalized exercises based on each learner's performance, adjusting difficulty and feedback as they progress. This helps keep the right level of challenge for every learner and boosts engagement (Liu, 2023). Using advanced natural language processing (NLP) algorithms, AI tools can better understand complex sentence structures and provide real-time corrections.

4.2 Instructional Integration Optimization

For AI tools to reach their full potential, they must be effectively integrated into the instructional process. This requires seamless coordination between the tools and the curriculum. The goal is to clarify the specific points where AI tools are applied within the learning process: pre-class, in-class, and post-class. Tools can assist with courseware creation (pre-class), grammar parsing (in-class), and assignment grading (post-class). Clearly defining these application points will improve overall teaching efficiency by more than 40%.

Teachers must also be equipped with the essential skills to incorporate AI tools into their teaching methods. This involves targeted training that not only covers how to operate the tools but also how to effectively integrate them into lesson plans, assignments, and assessments. Well-trained teachers can better guide students in using AI tools to correct errors and strengthen grammar skills within meaningful contexts (Liu, 2025). By ensuring teachers are proficient in integrating AI tools, their effectiveness in grammar instruction will be maximized.

4.3 Cross-Cultural Adaptation Optimization

AI tools need to be adaptable to learners' diverse cultural and linguistic backgrounds. Currently, many tools lack sufficient cross-cultural flexibility, which limits their effectiveness in different educational settings. The goal is to create a more inclusive AI tool that can serve learners from various cultural backgrounds by enhancing its ability to identify and fix culturally specific grammar issues, such as those caused by language transfer from the native language.

To achieve this, AI tools should be equipped with a multicultural database of grammar errors that includes common mistakes made by learners from various linguistic backgrounds. This database should cover at least 10 different cultural backgrounds, ensuring the tool can provide culturally relevant corrections and feedback. Additionally, situational practice scenarios should be designed to incorporate diverse cultural contexts, allowing learners to practice grammar in more appropriate and practical ways. This cross-cultural adaptability will enhance the tool's applicability and effectiveness in a global educational environment (Zhou, 2023).

5. Conclusion

This study highlights key factors affecting the effectiveness of AI tools in teaching English grammar, including individual learner traits, tool design, and integration into instruction. It stresses that personalized feedback, adaptive learning, and practical teacher training are crucial to maximizing the benefits of AI tools. The suggested improvement strategies—such as improving tool accuracy, better integrating them into the curriculum, and customizing tools for different cultural contexts — are essential for increasing AI's effectiveness in grammar teaching.

For future research, empirical studies are needed to evaluate the practical impact of these improvement strategies. Long-term studies examining the effects of AI tools on grammar learning across various cultural contexts would also be valuable. Furthermore, investigating

how AI tools are integrated into different educational environments and their scalability can help optimize their use in diverse classrooms.

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