



Exploring the Impact of AI and Digital Tools on EFL Writing Instruction in Higher Education: A Meta-Analysis of Global and Thai Contexts

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ABSTRACT

The objective of this meta-analysis is to explore the impact of artificial intelligence (AI) and digital tools on English as a Foreign Language (EFL) writing instruction in higher education, focusing on their effectiveness in enhancing grammar, coherence, and vocabulary. By reviewing peer-reviewed articles published between 2010 and 2024, the study aggregates quantitative and qualitative findings using meta-analytic techniques to assess the overall impact of these technologies on writing outcomes. Findings show that AI tools, such as intelligent tutoring systems and automated writing evaluation software, offer personalized feedback that significantly improves writing performance and student engagement. Digital tools, including online writing platforms and collaborative software, promote interactive and student-centered learning, particularly in the Thai educational context, where traditional methods often fall short. Despite their potential, challenges such as limited technology access and varying digital literacy levels present barriers to effective implementation. The study highlights the transformative potential of AI and digital tools in providing personalized and effective learning experiences in EFL writing instruction. Policymakers should prioritize these technologies by funding technological infrastructure and professional development for educators. Future research should expand access to these tools, develop culturally relevant instructional materials, and explore their long-term impact on writing skills to inform policy decisions and improve instructional practices in EFL education.

Keywords: Artificial intelligence, digital tools, EFL writing instruction, higher education, Thai context

Introduction

The integration of technology in English as a Foreign Language (EFL) education has surged over the past decade due to advancements in artificial intelligence (AI) and digital tools. Proficiency in English, especially in writing, is crucial for academic and professional success in a globalized world. Traditional EFL writing instruction, focused on rote memorization and grammatical accuracy, often fails to develop comprehensive writing skills needed for effective communication (Guo & Xu, 2020; Bacha, 2010). Consequently, there is a growing interest in using technology to create personalized and interactive learning experiences. AI and digital tools, like intelligent tutoring systems and online writing platforms, enhance EFL writing instruction by offering real-time feedback and adaptive learning paths (Hsiao & Chang, 2023; Song & Song, 2023).

EFL writing instruction traditionally emphasizes grammar and vocabulary, neglecting higher-order skills such as argumentation and critical thinking (Bacha, 2010). Studies by Guo and Xu (2020) and Al-Hammadi and Sidek (2014) highlight the need for approaches that engage students in meaningful writing tasks. Modern methods increasingly include communicative and process-oriented strategies, like peer review and genre-based tasks, to develop these skills (Miyazoe & Anderson, 2010). Technology, including tools like WebQuest and Google Classroom, revolutionizes EFL writing by facilitating interactive and student-centered learning (Dousti et al., 2021; Rosyada & Sundari, 2021). Despite these advancements, challenges remain, particularly in areas with limited access to technology and varying digital literacy levels among educators and students (Chanwaiwit & Inpin, 2021; Hendrajaya, 2023).

AI technologies, such as natural language processing and machine learning, offer personalized and adaptive learning experiences. AI tools provide real-time feedback, helping students correct errors and improve writing quality. Research indicates that AI-assisted tools significantly enhance writing skills, including grammar and coherence (Song & Song, 2023; Shen et al., 2023). AI's personalized feedback supports individualized learning paths, addressing each student's unique needs (Hwang et al., 2023; Kawinkoonlasate, 2021). However, integrating AI poses challenges like data privacy concerns, the need for substantial infrastructure, and potential biases (Guo & Xu, 2020; Widiati et al., 2023).

Digital tools are now integral to writing instruction, providing resources for various writing stages. Tools like online platforms, digital storytelling, and collaborative software support the writing process, enhance engagement, and improve outcomes (Dousti et al., 2021; Hsiao & Chang, 2023). Platforms like Google Classroom and WebQuest offer structured environments for writing tasks and

feedback, while tools like Storybird and Adobe Spark enable multimedia storytelling. Collaborative software such as Google Docs facilitates peer review and real-time collaboration (Hsiao & Chang, 2023). However, challenges like limited technology access and varying digital literacy levels necessitate ongoing support and training for educators (Chanwaiwit & Inpin, 2021; Hendrajaya, 2023).

Thailand's diverse linguistic and cultural backgrounds and varying English proficiency levels present unique challenges for EFL education. Traditional instruction often relies on rote learning, limiting genuine language proficiency (Chanwaiwit & Inpin, 2021; Thi, 2019). Digital tools have shown promise in addressing these challenges, improving writing skills through continuous feedback and peer review (Kawinkoonlasate, 2021; Thi, 2019). However, issues like limited technology access and digital literacy disparities must be addressed to realize these tools' potential fully (Boonsuk & Ambele, 2021). AI's use in Thai EFL writing instruction is in its early stages but shows potential for significant improvements (Chanwaiwit & Inpin, 2021; Hendrajaya, 2023). Future efforts should focus on expanding access, providing professional development, and developing culturally relevant materials.

Despite the potential benefits of integrating AI and digital tools in EFL writing instruction, significant gaps remain in their adoption, particularly in regions with limited technological infrastructure and varying digital literacy levels. Traditional teaching methods fail to address the comprehensive writing skills required for effective communication, leading to a need for innovative instructional approaches. This research aims to explore the impact of AI and digital tools on EFL writing instruction in higher education, with a focus on both global and Thai contexts, to identify best practices and areas for improvement.

Research Objectives

The primary objective of this meta-analysis is to evaluate the impact of AI and digital tools on EFL writing instruction in higher education. Specifically, the study aims to assess the effectiveness of these technologies in improving writing skills, identify the challenges and solutions associated with their use, and compare the outcomes in both global and Thai educational contexts. By synthesizing research findings from 2010 to 2024, this study seeks to provide insights that can inform policy decisions, enhance instructional practices, and guide future research in EFL education (Shen et al., 2023; Hwang et al., 2023).

Study Selection Criteria

The selection criteria for this meta-analysis included peer-reviewed journal articles published between 2010 and 2024, focusing on the impact of AI and digital tools on EFL writing instruction. Studies were required to have high citation counts and be accessible as full-text documents to ensure the reliability and retrievability of the data. Both qualitative and quantitative research were considered to provide a comprehensive analysis of the topic.

Table 1: Summary of Study Selection Criteria

Criterion	Description
Publication Year	2010 - 2024
Journal Type	Peer-reviewed, high impact factor (Q1-Q2)
Focus Area	Impact of AI and digital tools on EFL writing instruction
Citation Counts	High citation counts in Scopus and Google Scholar
Accessibility	Full-text documents available
Research Type	Both qualitative and quantitative studies considered
Geographical Scope	International studies and specific focus on Thailand

Data Extraction and Synthesis

Data were extracted from the selected studies using a systematic approach that involved reviewing the full text of each study to identify key variables such as the types of AI and digital tools used, their effectiveness in enhancing writing skills, and the specific challenges identified. The extracted data were then synthesized to draw comparative insights across different contexts, focusing on common themes and trends. The synthesis involved categorizing studies based on their findings and comparing the results to identify differences and similarities between global and Thai contexts.

Analysis Framework

The analysis framework for this meta-analysis involved evaluating the effectiveness of AI and digital tools in terms of writing performance improvements, learner engagement, and satisfaction. This included a detailed examination of the impact of these technologies on various aspects of writing, such as grammar, coherence, and vocabulary. The framework also involved a comparative analysis of the challenges and solutions identified in different contexts, focusing on

how cultural and contextual factors influence the effectiveness of these technologies. The goal was to provide a comprehensive understanding of the potential of AI and digital tools to enhance EFL writing instruction in higher education.

Table 2: Data Extraction and Analysis Techniques

Step	Description
Study Selection	Identify relevant studies using inclusion and exclusion criteria
Data Extraction	Extract key data points such as study focus, methodologies, and findings
Data Synthesis	Compile and compare data to identify trends, similarities, and differences across studies
Analysis Framework	Evaluate effectiveness of AI and digital tools using metrics such as writing performance and learner engagement
Comparative Analysis	Compare findings across global and Thai contexts to understand cultural and contextual influences

Data Collection and Analysis Techniques

Data collection involved gathering relevant studies from online databases such as Scopus, Google Scholar, and academic journal repositories. Each study was reviewed and coded based on predefined criteria, including the type of technology used, research methodology, and key findings. Quantitative data were analyzed using statistical techniques to assess the impact of AI and digital tools on writing performance, while qualitative data were analyzed using thematic analysis to identify common themes and insights. The findings were synthesized to provide a comprehensive overview of the current state of research on this topic.

Findings and Discussion

1. Global Perspectives on EFL Writing and AI

Globally, the integration of AI in EFL writing instruction has been recognized for its potential to enhance learning experiences by providing personalized feedback and adaptive learning environments. Studies such as those by Song and Song (2023) and Hwang et al. (2023) highlight the significant impact of AI tools, including intelligent tutoring systems and automated writing evaluation software, on writing performance and learner motivation. These tools offer real-

time feedback that helps students improve their writing skills by identifying and correcting errors, leading to a deeper understanding of the writing process.

The benefits of AI for learners are numerous, including increased engagement and motivation. AI tools create interactive learning experiences that support independent learning and foster a positive attitude towards writing. Research by Shen et al. (2023) suggests that students who use AI-assisted writing tools are more likely to develop a positive attitude towards writing and are more engaged in the learning process. Additionally, the ability of AI to provide personalized feedback and support is a key factor in its effectiveness, as it allows for more targeted and individualized learning experiences.

Despite these benefits, the implementation of AI in EFL writing instruction presents several challenges. Issues related to data privacy, the need for substantial investment in technology infrastructure, and the potential for bias in AI systems must be addressed to ensure that these tools are used effectively and ethically. Research by Guo and Xu (2020) emphasizes the importance of addressing these challenges to fully realize the potential of AI in language education.

Table 3: Key Findings from Selected Studies

Study	Focus Area	Key Findings	Context
Song and Song (2023)	AI-assisted writing instruction	Significant improvements in writing skills and learner motivation	China
Hwang et al. (2023)	AI tools for EFL writing	Enhanced grammar, coherence, and vocabulary in students' writing	Taiwan
Dousti et al. (2021)	Digital tools in writing instruction	Improved writing performance through WebQuest-based instruction	Iran
Shen et al. (2023)	AI-generated feedback in writing	Real-time feedback led to better writing accuracy and complexity	China
Kawinkoonlasate (2021)	E-writing programs for Thai EFL learners	Increased student engagement and improved writing skills	Thailand
Thi (2019)	Reflective teaching in EFL writing instruction	Positive impact on teaching practices and student outcomes	Thailand
Rosyada and Sundari (2021)	Google Classroom for academic writing	Effective platform for continuous feedback and peer review	Indonesia

2. Insights from Thai Context

Thailand presents a unique context for EFL education, with a diverse linguistic and cultural landscape and varying levels of English proficiency among students. Traditional EFL writing instruction in Thailand often relies on rote learning and memorization, which can limit the development of genuine language proficiency. Studies by Chanwaiwit and Inpin (2021) and Thi (2019) highlight the need for more engaging and interactive teaching methods that provide opportunities for meaningful communication and authentic language use.

The integration of digital tools in Thai EFL education has shown promise in addressing some of the challenges faced by learners and educators. Research by Kawinkoonlasate (2021) and Thi (2019) indicates that tools like Google Classroom and e-writing programs can improve writing skills by providing continuous feedback and facilitating peer review. However, challenges such as limited access to technology and varying levels of digital literacy must be addressed to fully realize the potential of digital tools in EFL education in Thailand (Boonsuk & Ambele, 2021).

The use of AI in EFL writing instruction in Thailand is still in its early stages, but initial research suggests that it has the potential to significantly enhance learning outcomes. Studies by Chanwaiwit and Inpin (2021) and Hendrajaya (2023) indicate that AI tools can provide personalized feedback and support that helps students improve their writing skills. Future directions for EFL writing instruction in Thailand should focus on expanding access to these technologies, providing professional development for educators, and developing culturally relevant instructional materials.

Table 4: Key Findings from Studies on EFL Writing in Thailand

Study	Focus Area	Key Findings	Context
Dueraman (2015)	Introduction to English writing	Identified critical period for introducing English writing to Thai students	Thailand
Chanwaiwit and Inpin (2021)	Collaborative writing instruction	Highlighted challenges and solutions for collaborative writing instruction	Thailand
Thi (2019)	Reflective teaching practices	Emphasized the impact of reflective teaching on EFL writing instruction	Thailand

Kawinkoonlasate (2021)	E-writing program	Demonstrated improvements in writing skills through digital tools	Thailand
Wichanpricha (2020)	Role of feedback in writing improvement	Underlined the importance of feedback for novice writers in higher education	Thailand
Hendrajaya (2023)	EFL teachers' perceptions of online education	Explored the perceptions and challenges of online EFL education during COVID-19	Thailand

3. Impact of AI on Writing Skills

AI tools have been shown to significantly enhance writing skills by providing personalized feedback, automating repetitive tasks, and creating engaging learning environments. Research by Song and Song (2023) and Hwang et al. (2023) indicates that AI-assisted writing tools can lead to substantial improvements in various aspects of writing, including grammar, coherence, vocabulary, and overall writing quality. These tools offer real-time feedback that helps students identify and correct errors, leading to a deeper understanding of the writing process and improved writing skills over time.

One of the key benefits of AI tools is their ability to provide personalized feedback tailored to each student's needs. Studies by Shen et al. (2023) and Hwang et al. (2023) demonstrate that AI tools can analyze students' writing in real time and provide immediate feedback on grammar, vocabulary, and writing style. This personalized feedback helps students identify and correct errors, leading to more accurate and effective writing. Additionally, AI tools can create personalized learning paths that guide students through the writing process and provide targeted support where it is needed most.

In addition to improving writing skills, AI tools can also enhance critical thinking and creativity by providing opportunities for students to engage in more complex and meaningful writing tasks. Studies by Song and Song (2023) and Shen et al. (2023) indicate that AI tools can support the development of higher-order thinking skills by providing opportunities for students to analyze, evaluate, and synthesize information in their writing. These tools can also encourage creativity by allowing students to experiment with different writing styles and formats and receive feedback on their efforts.

4. Digital Tools in Writing Instruction

Digital tools have become essential in modern writing instruction, offering a range of resources and platforms that support various aspects of the writing process. Tools such as online learning management systems, digital writing platforms, and collaborative software provide structured environments for writing tasks, facilitate feedback and collaboration, and create engaging learning experiences. Research by Dousti et al. (2021) emphasizes the growing role of digital tools in education, noting their ability to enhance student engagement and learning outcomes.

Several types of digital tools are commonly used in writing instruction, including online writing platforms, digital storytelling tools, and collaborative writing software. Platforms like Google Classroom and WebQuest provide structured environments for writing tasks, while tools like Storybird and Adobe Spark allow students to create multimedia stories. Studies by Hsiao and Chang (2023) and Rosyada and Sundari (2021) demonstrate the effectiveness of these tools in supporting writing instruction by providing opportunities for practice, feedback, and collaboration.

Despite the benefits, integrating digital tools in writing instruction presents several challenges, such as limited access to technology and varying levels of digital literacy among students and teachers. Research by Chanwaiwit and Inpin (2021) and Hendrajaya (2023) underscores the importance of addressing these challenges to ensure that digital tools are used effectively in educational settings. There is a need for ongoing support and training for educators to help them integrate these tools into their teaching practices and develop the necessary digital literacy skills.

5. Challenges and Solutions

Writing instruction, particularly in EFL contexts, faces several challenges, including limited access to resources, varying levels of English proficiency, and a lack of qualified teachers. Research by Chanwaiwit and Inpin (2021) and Dueraman (2015) highlights the difficulties faced by educators in providing effective writing instruction, including the need for more interactive and student-centered approaches that engage learners and provide opportunities for meaningful practice and feedback.

One of the primary challenges in writing instruction is the limited access to resources, particularly in low-income and rural areas. Many schools lack the funding and infrastructure needed to provide students with access to digital tools and resources that can support writing instruction. Research by Wichanpricha (2020) indicates the need for more investment in technology and resources to ensure that all students have access to the tools and support they need to develop

their writing skills. Additionally, there is a need for more support and training for teachers to help them effectively integrate these tools into their teaching practices.

Another significant challenge is the varying levels of English proficiency among students, which can make it difficult to provide effective instruction that meets the needs of all learners. Research by Dueraman (2015) and Thi (2019) highlights the need for differentiated instruction that provides targeted support and feedback for students at different proficiency levels. This can involve using personalized learning paths and adaptive learning technologies that provide individualized support and feedback for each student. Additionally, there is a need for more professional development for teachers to help them develop the skills needed to effectively teach writing to students with varying levels of English proficiency.

Recommendations

1. Policy Implications

Policymakers should prioritize integrating AI and digital tools in EFL instruction by providing sufficient funding for technological infrastructure and professional development for educators. This includes investing in the necessary technology and resources to ensure all students have access to tools and support to develop their writing skills. Research by Wichanpricha (2020) and Hendrajaya (2023) highlights the importance of digital tools in creating engaging and interactive learning experiences that improve writing instruction. Additionally, policymakers should support developing culturally relevant instructional materials reflecting students' diverse linguistic and cultural backgrounds. Developing resources and materials that integrate digital tools into writing instruction and engage students from different cultural backgrounds is crucial (Dueraman, 2015; Thi, 2019). Policymakers should also support research and innovation in EFL writing instruction to apply the latest advancements in technology and pedagogy. Supporting research on AI and digital tools' effectiveness in writing instruction and developing innovative teaching methods can improve writing instruction and support writing skills development in EFL learners (Wichanpricha, 2020; Hendrajaya, 2023).

2. Practical Recommendations for Educators

Educators should adopt a blended learning approach combining traditional instruction with AI and digital tools to provide a balanced and flexible learning experience. Using AI tools for personalized feedback and digital tools for engaging and interactive learning experiences can significantly improve writing performance (Song & Song, 2023; Hsiao & Chang, 2023). Educators

should also provide personalized feedback and support to help students develop their writing skills. AI tools can analyze students' writing and provide immediate feedback on grammar, vocabulary, and writing style, offering targeted support and guidance (Shen et al., 2023; Hsiao & Chang, 2023). Additionally, educators should use digital tools to create engaging and interactive learning experiences that support writing skills development. This includes online writing platforms, digital storytelling tools, and collaborative writing software that offer opportunities for practice, feedback, and peer collaboration (Dousti et al., 2021; Hsiao & Chang, 2023).

3. Future Research Directions

Future research should explore the long-term impact of AI and digital tools on EFL writing skills and identify best practices for their integration in various educational contexts. This includes studying the effectiveness of different AI tools and digital platforms in improving writing performance and investigating the impact of these technologies on learner motivation, engagement, and outcomes (Song & Song, 2023; Shen et al., 2023). Additionally, future research should examine the role of cultural and contextual factors in shaping the effectiveness of AI and digital tools in writing instruction. Understanding how different cultural backgrounds and educational contexts influence these technologies' use and identifying best practices for diverse settings is essential (Dueraman, 2015; Thi, 2019). Finally, research should focus on developing advanced AI tools and digital platforms that provide deeper, nuanced feedback on writing. Exploring new technologies such as natural language processing and machine learning for more accurate and personalized feedback and integrating these technologies with other digital tools can create more engaging and effective learning environments (Song & Song, 2023; Shen et al., 2023).

Limitations of the Study

One limitation of this meta-analysis is the focus on studies published in English, which may exclude relevant research published in other languages. Additionally, the reliance on accessible full-text documents means that some high-quality studies that are not freely available may have been excluded. Another limitation is the potential for publication bias, as studies with positive findings are more likely to be published and included in the analysis. Despite these limitations, the study provides valuable insights into the impact of AI and digital tools on EFL writing instruction and highlights the need for further research in this area.

Conclusion

This meta-analysis highlights the significant potential of AI and digital tools in enhancing EFL writing instruction in higher education. The findings indicate that AI and digital tools can significantly improve various aspects of writing, including grammar, coherence, vocabulary, and overall writing quality. Both global and Thai contexts show promising results in terms of improved writing skills, increased learner engagement, and positive perceptions of technology-enhanced learning. The integration of these technologies provides personalized feedback, supports independent learning, and creates more engaging and interactive learning environments.

The findings underscore the importance of integrating AI and digital tools in EFL instruction to provide more personalized, engaging, and effective learning experiences. To fully realize the potential of these technologies, there is a need for ongoing investment in technology and resources, support for professional development, and the development of culturally relevant instructional materials. Additionally, future research should continue to explore the long-term impact of these technologies on writing skills and identify best practices for their integration in diverse educational contexts. By addressing these challenges and supporting the integration of AI and digital tools in EFL writing instruction, educators and policymakers can help to ensure that all learners have access to the resources and support they need to develop the writing skills necessary for academic and professional success.

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