

COMPUTER-BASED TECHNOLOGY ON WRITING PERFORMANCE: A SYSTEMATIC LITERATURE REVIEW

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Article Info	Abstract
Article History Received: February 2024 Revised: March 2024 Published: April 2024	<i>This systematic literature review delves into the transformative effects of computer-based technology on writing performance, with a specific focus on studies conducted between 2017 and 2023. The review scrutinizes the impact of a diverse array of technologies, ranging from popular platforms like TikTok, Twitter, and Instagram to specialized tools such as Grammarly, Digital Storytelling, and Kahoot. By synthesizing findings from these studies, the review elucidates the multifaceted ways in which technology influences students' writing proficiency. Key findings underscore the nuanced impacts of these technologies, revealing their significant roles in fostering motivation, enhancing language skills, promoting engagement, and facilitating collaborative learning environments. Notably, Grammarly emerges as a prominent tool widely utilized to address grammatical, spelling, and punctuation errors, thereby aiding in the refinement of writing quality. Meanwhile, platforms like Instagram are recognized for nurturing creativity, Twitter for facilitating personalized learning experiences, and Kahoot for fostering active engagement through interactive quizzes and games. By illuminating the diverse dimensions of technology's transformative role in writing performance, this review offers valuable insights for educators, policymakers, and researchers alike. It underscores the importance of leveraging technology as a strategic tool to enhance students' writing skills and foster a dynamic and enriching learning experience. Moreover, it highlights the need for continued exploration and adaptation of innovative technological solutions to meet the evolving needs of modern education.</i>
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INTRODUCTION

The ability to write is a crucial skill that carries considerable importance across different facets of life. It extends beyond basic communication with family and friends, encompassing activities such as storytelling, information sharing, and expressing ideas. Language learners who excel in writing from an early stage tend to develop effective communication skills, critical thinking abilities, and the capacity to express ideas clearly and persuasively. In the academic context, strong writing skills are often correlated with academic success, as effective communication is a fundamental aspect of learning and assessment (Tusino, Dewi & Saputro, 2022). Moreover, as learners progress into higher education and

later enter the workforce, the ability to convey thoughts and ideas through writing becomes a crucial competency.

The rapid adoption of technology is emerging as a central tool in the field of language learning. As writing is a fundamental component of language acquisition, the use of technological devices is pivotal in the training of learners in both English as a Foreign Language (EFL) and English as a Second Language (ESL) contexts, particularly over the last two decades. Contemporary research studies increasingly emphasize the synergy between writing and technology, extensively Analyzing the influence of technology on improving writing proficiency (Alharbi, 2019; Barrot, 2020). In these recent investigations, the focus is on understanding how technology can contribute to improvements in writing skills within the realms of EFL and ESL education.

Classroom computers have been utilized as instruments for word processing, providing valuable assistance to developing or struggling writers in the electronic composition and easy editing of text. Graham, Gillespie, and McKeown (2013) have reported that the application of word processing tools has proven to enhance the writing proficiency of individuals with lower writing skills, positively impacting both the quality and quantity of their written work. Additionally, these tools have been observed to enhance the motivation of struggling writers, offering a supportive environment that fosters improvements in their writing skills. Tools such as spelling and grammar checkers, formatting options, a planning/ outlining features are recognized as valuable supports. These not only motivate "reluctant" writers to engage in the writing process, as observed by the International Reading Association (2009), but also contribute to improving the overall quality of their writing.. These tools provide practical assistance by identifying and correcting errors in spelling and grammar, ensuring that the written work meets linguistic standards. Additionally, formatting features aid in structuring the content effectively.

Furthermore, the planning and outlining tools offer support in organizing ideas coherently before actual writing begins. As highlighted by Koehler and Mishra (2006), this functionality allows writers to refine or eliminate ideas easily, contributing to the clarity and refinement of their written expression. In essence, these technological supports not only address the hesitancy of some writers but also play a pivotal role in elevating the quality of their writing through improved organization, language accuracy, and overall presentation.

The integration of computers in the writing process has been shown to positively impact students' work (Williams & Beam, 2019). These findings indicate that students who utilize computers tend to produce written pieces of greater length and higher quality. Furthermore, the use of mobile phones and applications in writing classes has been recognized as a valuable tool for enhancing learners' motivation, fostering creativity, and improving their ability to generate innovative ideas while addressing punctuation and sentence structure errors (Estarki & Bazyar, 2016). For example, Tam (2012) further highlights the advantages of mobile phones by emphasizing that they provide learners with opportunities for writing practice beyond the confines of traditional educational settings, allowing for continuous skill development even outside schools and universities. In summary, the incorporation of technology, including computers and mobile devices, offers multifaceted benefits in writing education, ranging from improved writing quality to increased motivation and accessibility for learners.

The integration of computers in the writing process has been shown to positively impact students' work, as evidenced by studies such as Williams and Beam (2019). These findings indicate that students who utilize computers tend to produce written pieces of greater length and higher quality. Additionally, the use of mobile phones and applications in writing classes has been recognized as a valuable tool for enhancing learners' motivation, fostering creativity, and improving their ability to generate innovative ideas while addressing

punctuation and sentence structure errors (Estarki & Bazayr, 2016; Fattah, 2015; Kanala et al., 2013). Tam (2012) further highlights the advantages of mobile phones by emphasizing that they provide learners with opportunities for writing practice beyond the confines of traditional educational settings, allowing for continuous skill development even outside schools and universities. In summary, the incorporation of technology, including computers and mobile devices, offers multifaceted benefits in writing education, ranging from improved writing quality to increased motivation and accessibility for learners.

Recent focus has turned towards exploring the benefits of integrating various technological devices to enhance learners' writing skills. Iwasaki et al. (2019) emphasize the importance of e-learning in developing academic writing proficiency. Ellison and Drew (2020) confirm the effectiveness of computer games in fostering critical thinking and refining organizational skills among writers. Several authors highlight technology's crucial role in creating an optimal learning environment, boosting motivation for writing, and enhancing both the quality and quantity of students' outputs. Moreover, technology is acknowledged for its potential to save time for both learners and instructors while reducing errors through improved editing facilities (Baker & Lastrapes, 2019; Gharehblagh & Nasri, 2020). This expanding body of literature underscores the manifold advantages of diverse technological tools in shaping a more effective and efficient approach to writing education.

This study intends to examine the role and impact of computer-based technology in the improvement of writing performance. This involves investigating how various technological tools, such as word processors, digital writing platforms, and educational software, have been utilized in writing education. The research aims to synthesize existing research findings to understand the effectiveness of computer technology in enhancing writing proficiency. This review provides a comprehensive analysis that informs educators, researchers, and policymakers about the current state and potential advancements in leveraging computer technology to develop writing.

The present state of technology in English as a Foreign Language (EFL) education reveals a significant gap in the creation of word processors specifically designed for EFL purposes, with limited research exploring their potential impact on writing proficiency. This study aims to bridge this gap by examining a technology which has not yet gained widespread use in EFL contexts. Despite the relative underdevelopment in this specific domain, it is crucial to acknowledge the swift pace of technological progress. Technology is advancing rapidly, fundamentally transforming how second language (L2) students participate in the writing process (Zheng & Warschauer, 2017). The research questions are formulated as follows: How is integration of computer-based technology and language pedagogy on writing performance? And What are the impacts of computer-based technology on learners' writing?

RESEARCH METHOD

Research Design

This research adheres to the systematic and methodological standards prescribed by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, which is a widely recognized and routinely updated reporting guideline in the field of systematic review methodology (Kitchenham et al., 2009).

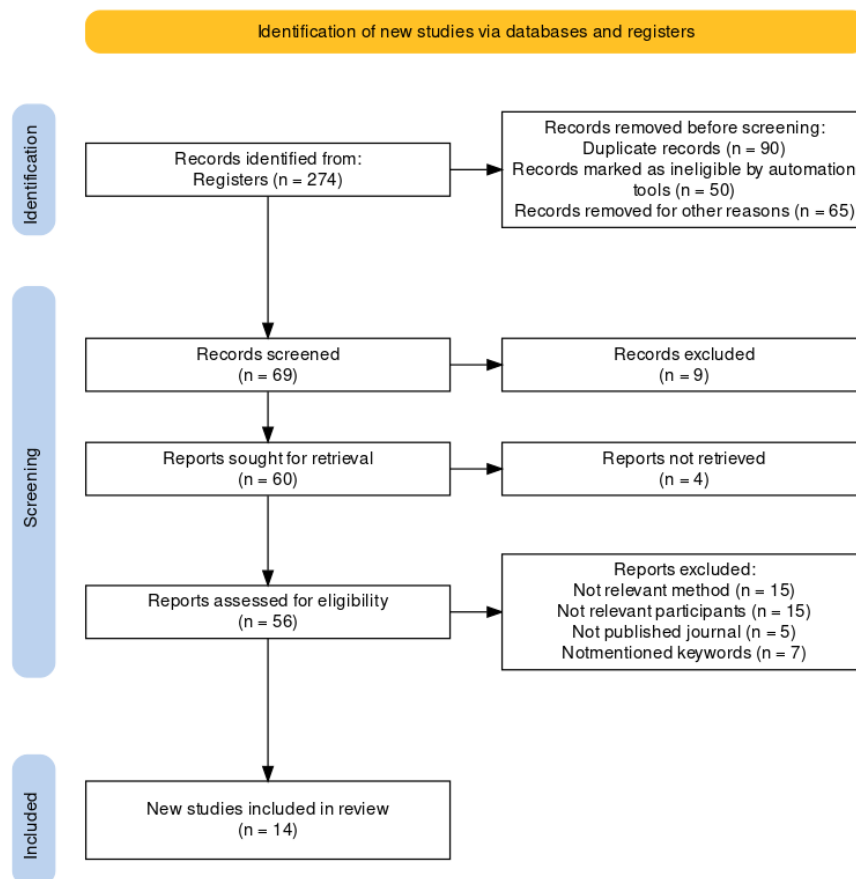


Figure 1. Systematic Literature Review Process

Data Collection

A systematic approach has been employed to identify pertinent preliminary studies that align with the current research focus. The authors conducted a comprehensive exploration across three databases—ERIC (Educational Information Resource Center), Clarivate, and Web of Science (Social Science Citation Index)—to compile a body of studies relevant to Second Language Acquisition (SLA). These databases furnished detailed information, including titles, keywords, and abstracts. The search specifically honed in on keywords like "social media to enhance writing" and "digital app to improve writing." This focused strategy aimed to uncover insights pertinent to the impact of social media and digital applications on the improvement of writing skills within the context of second language acquisition.

Furthermore, the authors conducted searches in computer-assisted language learning (CALL) journals, applied linguistics journals, and educational technology journals. This targeted exploration was designed to encompass a diverse range of sources that are pertinent to the intersection of applied linguistics, language learning technology, and educational technology. The researcher performed a manual search on Google Scholar to ensure the thoroughness of the initial exploration. This step aimed to uncover any studies that might have been missed or not included in the targeted journals and consulted databases. Google Scholar, being a comprehensive database, includes journals that may not be indexed in ERIC or Web of Science, providing an additional layer of scrutiny to capture a broader spectrum of relevant literature.

Data Analysis

A set of inclusion criteria was applied to ensure a thorough search, ensuring that the retrieved studies met specific standards. The pivotal study was to conduct a detailed examination of the various computer technologies employed with the specific intent of improving writing skills. This investigation identified and understood the diverse tools, applications, or platforms utilized in educational settings to enhance the writing proficiency of learners.

The study was dedicated to investigating how the use of computer technology influences and improves writing skills. It aimed to explore the specific platforms and impacts of integrating various computer technologies to understand their effectiveness in enhancing writing proficiency across different educational settings. The research intended to provide concise insights into the relationship between computer technology and improved writing skills.

The papers were removed from consideration in the research if they satisfied any of the following criteria. The study explored various types of computer technology but did not specifically focus on their role in enhancing writing skills. The study investigated different types of computer technology but did not identify applications suitable for developing writing skills. The study examined the computer technology to improve writing performance in secondary schools.

Table 1
The Study's Inclusion and Exclusion Criteria

Inclusion	Criteria	Exclusion
The studies reported using English	Language	Not reported in English
The articles must be published between 2017-2023	Years of Published	The studies published before 2017
The studies covered quantitative and qualitative method (CAR, experiment, case study)	Research method	The studies were (Systematic Literature Reviews, conceptual papers, literature reviews, and Meta- analyses) that were not grounded in research or study
Published as journals/articles	Literature type	Not published as a journal (conference proceeding, and chapter in book)
The study was conducted in secondary schools	Participants	Not in the scope of secondary schools
Completed paper (keywords, findings, and discussion)	Content	Not fully completed
The independent variable must involve any form of computer-based technology, whether it be an application or software, designed to support writing skills.	Technology	Not use technology

Table 1 shows that the inclusion criteria for this investigation are designed to establish a thorough and contemporary comprehension of the role played by information and communication technology (ICT) in improving writing skills within secondary school settings. By confining the language to English and limiting publication years ranging from 2017-2023, the emphasis is on recent and widely accessible research. The incorporation of both quantitative and qualitative methodologies, including Content Analysis of Research (CAR), experiments, and case studies, ensures a nuanced exploration of the subject. Prioritizing published journals or articles adds an extra layer of credibility to the chosen

studies, while the requirement for completed papers guarantees a comprehensive analysis of keywords, findings, and discussions. The study's scope is specifically narrowed down to secondary schools, and the pivotal independent variable involves the application of ICT, ensuring a targeted investigation into the impact of technology on writing skills. Conversely, exclusion criteria rigorously filter out studies falling outside these specified parameters, ensuring a more focused and pertinent synthesis of existing literature.

RESEARCH FINDINGS AND DISCUSSION

Research Findings

To uncover the incorporation of computer-based technology, whether through applications or software, for the enhancement of writing performance in secondary schools, the systematic review considered studies published from 2017 to 2023.

Table 2
Computer-based Technology on Writing Performance

No	Author	Platform	Key Findings
1	Franciska et al., (2023)	Tiktok	The fusion of TikTok with a Problem-Based Learning (PBL) model emerges as a powerful approach to improve writing skills, especially in the realm of persuasive text. Through the integration of PBL and the TikTok application within the Lesson Plan framework (RPP), students can cultivate critical thinking skills, analyze real-world issues, grasp the structure and linguistic features of persuasive texts, and proficiently craft persuasive content. Notably, TikTok has shown a favorable influence on students' learning outcomes, particularly in the acquisition of vocabulary essential for writing.
2	Zakaria & Aziz (2019)	Digital Storytelling (DS)	Digital storytelling proves effective in enhancing students' writing skills, particularly in vocabulary and grammatical proficiency. It not only improves creativity and idea generation but also enhances overall content quality in writing. Aligned with the constructivism theories of Jean Piaget and Lev Vygotsky, the use of Digital Storytelling amplifies students' motivation to write and engages them effectively in the teaching-learning writing process. Additionally, Digital storytelling offers teachers an alternative approach to teaching narrative writing by integrating it into lessons. This contributes to the existing literature on Digital Storytelling, indicating the potential or diverse outcomes in various educational settings.
3	Ferdianto & Dwiniasih (2019)	Schoology Application	The Schoology Application, a digital learning platform, has demonstrated a substantial enhancement in student engagement and motivation throughout the learning process. The heightened interaction and participation among students underscore its effectiveness as an educational tool. Moreover, when integrated with the Guttman Theory, a method for scaling responses in social science research, the application has resulted in

No	Author	Platform	Key Findings
			significant improvements in students' behavior when acquiring the skill of writing descriptive texts. Notably, there was a observed increase in motivation following the application, indicating a positive shift in their learning experience.
4	Espinoza-Celi & Pintado (2020)	Twitter	<p>Twitter proves to be a motivating tool for students learning English as a foreign language, thanks to its user-friendly interface, the freedom to choose topics of interest, and the ability to follow a diverse user base. This dynamic platform enhances vocabulary and grammar proficiency by exposing students to a variety of topics.</p> <p>Furthermore, Twitter cultivates a dynamic and personalized learning environment, promoting heightened interaction and participation driven by increased student motivation. The platform also serves as a channel for teachers to provide feedback on students' uploaded writings, thereby offering additional support in their learning journey.</p>
5	Aisyah et al., (2023)	Instagram	<p>Instagram, a widely utilized social media platform, demonstrates the potential to enhance the ability to write descriptive texts. Its visually-rich environment fosters creativity and elevates the quality of writing among students. For English teachers, Instagram serves as a versatile teaching tool, providing a range of media, including images and short videos, that can be employed as instructional materials. This varied content introduces a sense of novelty into teaching methodologies, breaking the monotony associated with writing skills instruction.</p> <p>Additionally, Instagram's vibrant and engaging nature stimulates pupils' imagination and enhances their motivation to write. As students engage with diverse and captivating content, they are prompted to write more compelling and innovative pieces. Hence, Instagram serves not only as an entertainment platform but also as an educational resource supporting the development of students' writing skills.</p>
6	Gámez et al. (2018)	Plotagon	<p>Plotagon, a digital storytelling tool enabling animated movie creation from written text, is recognized for effectively increasing students' motivation to write. Pedagogically, Plotagon promotes the development of English writing skills in an engaging manner, turning learning into an enjoyable process. By prompting students to animate their stories, it enhances creative thinking and aids in narrative writing skill development. Significantly, Plotagon contributes to comprehensive language skills, encompassing listening and reading abilities. This multimedia approach serves as an effective tool for language acquisition. Additionally, Plotagon supports the development of social skills as students collaborate, engage in cooperative learning, and provide feedback to each</p>

No	Author	Platform	Key Findings
			other. This interactive setting fosters a positive learning environment, enhancing both academic and interpersonal skills.
7	Syapitri O. et al. (2023)	Grammarly	Grammarly is a highly effective tool in reducing writing errors, including grammar, spelling, and punctuation, leading to enhanced writing skills. The application provides real-time, comprehensive checks and immediate feedback, allowing students to correct mistakes instantly for a deeper understanding. This makes Grammarly a valuable support for students seeking to improve their writing skills, fostering positive attitudes toward the writing teaching and learning process. With its user-friendly interface and instant feedback, Grammarly makes learning enjoyable, instilling enthusiasm and motivation among students. In essence, Grammarly not only enhances the technical aspects of writing but also contributes to a more engaging and rewarding learning experience.
8	Herlinda et al. (2023)	Kahoot	Kahoot, an educational platform utilizing gaming and interactive elements, plays a crucial role in improving students' writing skills, especially in the creation of recount texts. It creates an environment that sparks idea generation and cultivates students' enthusiasm for learning and crafting such texts. The proven effectiveness of Kahoot in promoting engagement and active learning underscores its value as a valuable tool for writing instruction.

Discussion

Integration of computer-based technology and language pedagogy

By integrating a diverse array of computer technologies, educators can substantially augment writing instruction, offering students a multifaceted and personalized approach to enhancing their writing skills. Through the synthesis of various studies, valuable insights emerge regarding the myriad ways in which computer technologies can be effectively harnessed to elevate the quality of writing instruction and student outcomes. These studies underscore the versatility and efficacy of computer technologies in bolstering writing proficiency, showcasing their potential to cater to diverse learning needs and preferences. From specialized tools like grammar-checking software to interactive platforms such as digital storytelling applications, the reviewed literature demonstrates the breadth of technological resources available to support writing instruction. Moreover, the studies illuminate the nuanced strategies and pedagogical approaches that educators can employ to leverage computer technologies effectively in writing instruction. By embracing a tailored and innovative approach, educators can harness the power of technology to engage students, foster creativity, and cultivate essential writing skills.

TikTok, when combined with a Problem-Based Learning (PBL) model, proves beneficial for enhancing persuasive writing skills. Integrating TikTok can motivate students through the platform's interactive and engaging nature. The combination with PBL encourages critical thinking as students analyze real-life situations, aligning with the lesson plan for effective writing outcomes (Fransiska et al., 2023). Furthermore, Twitter's easy interface and the ability to choose preferred topics make it a motivational tool for language

learning. Educators can integrate Twitter to enhance students' vocabulary and grammar proficiency by exposing them to diverse topics. The interactive nature of the platform, including teacher feedback through comments, creates a dynamic and personalized learning environment (Espinoza-Celi & Pintado, 2020).

Instagram, recognized for fostering creativity, can be integrated to enhance descriptive text writing. Teachers can encourage students to use photographs and visual elements to inspire their writing. This approach not only stimulates imagination but also provides a platform for independent learning, allowing students to express their ideas through a visually engaging medium (Devy & Transinata, 2019; Sallamah et al., 2021)

Plotagon's use as a digital animation tool offers a unique approach to motivating students in writing. It can be integrated to encourage creative writing through the creation of animated stories. The tool's impact extends beyond writing, contributing to improvements in listening and reading abilities, and fostering a well-rounded language skill set (Gámez et al., 2019). The computer-based technology platforms can be an option to be utilized and integrated to maximize learners' writing performance.

Incorporating Grammarly into writing instruction emerges as a foundational step, especially considering its frequent mention as a valuable tool in the reviewed literature. Renowned for its capability to identify and rectify grammatical, spelling, and punctuation errors, Grammarly proves to be an invaluable companion for students striving to enhance their writing skills. Educators can leverage this tool to provide personalized feedback and guidance to students, thereby facilitating their development of a robust foundation in language mechanics (Fahmi & Rahmijati, 2021). By integrating Grammarly into the writing process, educators can empower students to refine their writing mechanics and cultivate a keen eye for language precision. The tool's real-time feedback feature enables students to identify and rectify errors promptly, fostering a continuous cycle of improvement in their writing proficiency. Moreover, Grammarly's accessibility and user-friendly interface make it an accessible resource for students of varying skill levels and learning preferences. Furthermore, the integration of Grammarly aligns with the broader objective of promoting autonomy and self-directed learning among students. By providing students with access to tools that facilitate self-assessment and improvement, educators empower them to take ownership of their learning journey and develop essential writing skills autonomously. In conclusion, the integration of Grammarly into writing instruction offers a strategic approach to supporting students in mastering language mechanics. By leveraging this tool, educators can provide personalized feedback and guidance, thereby fostering a strong foundation in writing proficiency among students.

Kahoot emerges as a potent tool for promoting active learning and fostering engagement, rendering it invaluable for collaborative writing activities in educational settings. Teachers can harness the interactive nature of Kahoot to craft engaging writing challenges or quizzes that align with key writing concepts and objectives. By doing so, educators not only reinforce fundamental writing skills but also cultivate a collaborative spirit among students, encouraging teamwork and social skills development (Herlinda et al., 2023). Through Kahoot's interactive platform, students are actively engaged in the learning process, as they participate in writing-related activities that are both enjoyable and educational. The gamified nature of Kahoot adds an element of excitement to writing exercises, motivating students to actively participate and strive for success. Additionally, Kahoot's user-friendly interface facilitates seamless collaboration among students, enabling them to work together to tackle writing challenges and quizzes. Furthermore, the incorporation of Kahoot into collaborative writing activities aligns with modern pedagogical approaches that prioritize active learning and student engagement. By leveraging Kahoot's interactive features, educators create

dynamic learning environments where students are empowered to take ownership of their learning and collaborate effectively with their peers.

Impacts of computer-based technology on learners' writing

Franciska, et al. (2023) emphasize the effectiveness of combining TikTok with a problem-based learning (PBL) model to improve writing performance, particularly in persuasive text. The integration of TikTok positively contributes to students' learning outcomes, especially in mastering vocabulary for writing and understanding the nuances of persuasive texts. Digital Storytelling (DS) is found to be effective in enhancing students' writing skills, focusing on improvements in language mechanics, creativity, and idea generation (Zakaria & Aziz, 2019). The integration of DS with Constructivist theories results in increased motivation among students to write, fostering greater engagement in the teaching- learning process.

Espinoza-Celi and Pintado (2020) explore the use of Twitter as a motivational tool for students learning English as a foreign language. Twitter is noted for its positive impact on enhancing vocabulary and grammar proficiency, creating a dynamic and personalized learning environment that increases student participation and motivation. Schoology, a digital learning platform, boosts student engagement by integrating the Guttman Theory, resulting in improved behavior when learning descriptive writing. Plotagon, a digital storytelling tool, promotes the development of writing skills by enabling users to create animated stories, fostering creative thinking and language skills. Digital storytelling, as a broader concept, utilizes various digital tools to improve writing skills, emphasizing creativity, idea generation, and content quality.

Instagram's reputation for fostering creativity and enhancing descriptive writing lies in its visually rich platform, where users predominantly share images and videos. The visual nature of the content on Instagram prompts individuals, including students, to focus on the picture and its story. Students are encouraged to pay attention to details, use vibrant language, and craft narratives that vividly describe the scenes captured in images or videos. The platform's features, such as photo captions and storytelling capabilities, provide a medium for practicing the art of articulating thoughts in a visually engaging way. By engaging with diverse visual content on Instagram, students can develop a heightened awareness of descriptive elements, ultimately refining their ability to express themselves vividly and imaginatively in their writing. The platform thus serves as an innovative and dynamic tool for nurturing creative writing (Purwandari, 2021; Zakaria & Aziz, 2019).

Grammarly stands out as a primary tool for improving writing skills. It offers instant feedback through a user-friendly interface, enabling personalized learning experiences for students to enhance their writing at their own pace. Beyond technical features, Grammarly enhances the learning process with suggestions for improving vocabulary and restructuring sentences, contributing to a more enjoyable and rewarding experience. Its widespread use underscores its role as a fundamental tool for students aspiring to refine their writing abilities. In educational settings, the extensive utilization of Grammarly reshapes writing practices, fostering a culture of immediate correction and continuous improvement. The tool's accessibility and practicality make it a preferred resource for students, facilitating a customized learning journey focused on individual improvement. Grammarly's positive influence extends beyond technical aspects, nurturing a motivated and enthusiastic writing culture within educational environments (Cynantia, 2021; Fahmi, & Rachmijati, 2021; Isnaniah & Maulida, 2022; Risa et al., 2022).

Kahoot plays a significant role in improving the creation of texts, leveraging its gamified and interactive elements. Through game-based learning, Kahoot transforms the recount text creation process into an engaging and interactive experience for students. The

incorporation of gamification elements, such as challenges, quizzes, and interactive tasks, captures students' attention and creates a dynamic learning environment (Herlinda, et al. (2023).

CONCLUSION

This systematic literature review aims to describe the integration and impacts of computer-based technology on writing performance. The integration of computer-based technology and language pedagogy in writing instruction reveals a nuanced understanding of the various strategies, benefits, and implications associated with this educational approach. The impacts of utilizing computer technology in writing classes cover critical thinking, motivation, social interaction, vocabulary development, and overall writing performance.

Future research could examine the potential correlation between technology integration in writing and students' overall academic performance. Exploring the effectiveness of specific writing applications, platforms, or tools in addressing different aspects of writing skills could offer targeted insights for educators. Additionally, investigating the impact of technology on fostering collaborative writing and peer feedback among students in Indonesian schools may contribute to understanding the social dynamics of technology-enhanced writing environments. Furthermore, studies could explore the challenges and opportunities associated with the integration of emerging technologies, such as artificial intelligence or virtual reality, in advancing writing skills. This multifaceted approach would contribute to a nuanced and comprehensive understanding of the evolving landscape of technology in writing.

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