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Enhancing ESL Learners' Metacognitive Writing Strategies Through Metaverse-Based Learning Environments

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Abstract

This conceptual study explores the role of AI-driven personalized feedback in the Metaverse as a transformative tool for enhancing ESL learners' metacognitive writing strategies. Writing in a second language presents significant challenges, particularly in self-monitoring, planning, and revising, due to the lack of immediate and personalized feedback in traditional learning environments. The Metaverse, with its AI-powered writing assistants, adaptive learning platforms, and immersive virtual spaces, provides an innovative solution to these challenges by fostering self-regulated learning and strategic writing development. AI-driven feedback mechanisms offer real-time, individualized support, helping learners refine their compositions through targeted suggestions on grammar, coherence, and organization. Additionally, gamification elements and interactive collaboration within the Metaverse further enhance motivation and engagement, encouraging learners to actively apply metacognitive strategies. This study highlights the implications of integrating AI-driven feedback into ESL writing instruction, emphasizing its potential to bridge the gap between automated learning and human instruction. It also underscores the need for future empirical research to assess the effectiveness of AI-enhanced writing environments. By leveraging the capabilities of AI and the Metaverse, educators and policymakers can revolutionize ESL writing instruction, empowering learners to become more independent, strategic, and confident writers in digital learning ecosystems.

Keywords: Metacognitive Writing Strategies, ESL Leaners, Metaverse Applications, Immersive Learning Environment, AI-Driven Feedback.

INTRODUCTION

Writing proficiency is one of the most challenging aspects of language learning for ESL students, requiring not only a strong command of vocabulary and grammar but also the ability to structure ideas coherently, maintain logical flow, and engage in critical thinking (Dendup, 2020; Meihua, 2009; Shahzadie et al., 2014). Writing does not come from that, because speaking is learned through direct experience, while writing is cognitively hard, thus more repetitions and feedback and revision is needed. ESL students have difficulties in many realms of writing: generating an idea, organizing that idea, ensuring coherence, as well as the usual linguistic accuracy issues. The primary problem is the absence of real-time, tailored feedback, which hampers learners in recognizing errors and developing better writing strategies. It's a reason why many students struggle to self-monitor their development as writers, resulting in perpetually weak writing skills. Routine approaches to writing instruction based almost exclusively on feedback from an instructor and standardized assessments tend to overlook the nuances of individual learners (Shahzadie et al., 2014). Feedback delay prevents students' iterative revision, much less the development of metacognitive writing strategies

(planning, self-monitoring, evaluation). Many ESL students are just passive writers, unable to control their writing process without effective guidance and structured support. These constraints of classical writing guided one to search for an inventive, computing-based writing environment that created self-regulated learning and offered students prompt, tailored, and interactive assistance.

These challenges can be addressed well by a universe of the Metaverse, which provides an immersive and AI-driven learning environment to help ESL learners improve their writing experience. As metaverse has important role in enhancing ESL learners' language acquisition and proficiency in higher educational institutions (Razzaq, 2020). In contrast to the usual teacher-centered classroom, the Metaverse applies VR, AR, and AI to offer a flexible, interactive, and immersive classroom for language learning. Metaverse allows AI comments on the grammar, coherence or organization of the work prepared by students in real time, and make suggestions for changes that will help refine their writing in a more self-directive and iterative manner. AI-powered writing assistants, for example, analyze students' texts in real time and generate tailored suggestions, showing learners where they're lagging and how to improve their writing. AI-powered brainstorming tools that help students map their ideas, organize systems of argument, and create logistic content are also used. AI eliminates the need for instructors to manual feedback process finetune, and also gives students the independence, can keep up with their learning journey.

In addition to real-time immediate feedback generated by AI, the Metaverse has the potential to provide an immersive learning context to ESL students to collaborate on and gamify writing initiatives that stimulate motivation and metacognitive strategy use. Web-based writing workshops, peer-review options, and interactive storytelling exercises all provide writing opportunities in a fun and collaborative environment. As such, we are fostering an environment that allows students to reflect on themselves, analyze their writing process, and strategize about composition itself (Reyes, 2020). Gamification elements in this phase (achievement badges, leaderboards and progress tracking) encourage users to engage in writing and apply metacognitive strategies. The Metaverse provides an ecosystem for ESL learners that is genuine and practical by combining AI-powered assistance, collaboration, and gamification to facilitate practice, refine, and perfect their writing skills.

The study is important in that it investigates the role of AI-enabled tailored feedback within the Metaverse as an innovative resource for improving the metacognitive writing strategies of ESL learners. Focusing on active, self-regulated engagement with their writing process instead of passive, instructor-oriented lessons, this study illustrates the power of AI and immersive technology to give students authority in their writing development (Razzaq, 2020). Educators must understand how AI-driven feedback creates metacognitive writing strategies, as it challenges what we believe teaching writing should look like, urging us to personalize instruction based on data and understanding what a conventional classroom can never achieve. This paper also added to the contemporary conversation of AI in education by investigating how such adaptive learning environments (Mekacher, 2019) in the Metaverse could potentially help mitigate the divide between robot-directed feedback and human instruction.

Additionally, the significance of this study also pertains to educators, policy-makers, and technology developers who are striving to implement AI-based approaches in language education, particularly in ESL learning. These details can be useful for policymakers to create an educational framework to include AI-powered tools in personal writing support for equal opportunities to students across the globe. Those who are crafting the technology, in turn, can feel about tweaking the Ai algorithms and interactive learning environments to serve the expressive spectrum of ESL learners. With the advent of AI, its potential to create tailored learning experiences will provide students with adaptive tools for planning, monitoring and revising their writing that will only become even more pronounced over time as AI continues to evolve. This study highlights the demand for a paradigm shift in ESL writing teaching. Traditional approaches are useful, they do not always provide the timing, personalization, and engagement that needs to be part of metacognitive strategies. The Metaverse, allowing for immersive, AI-driven feedback, participatory learning spaces, and gamification, is revolutionary not only in enhancing writing performance but also developing students into independent learners. Since the Metaverse is constantly evolving there may be more opportunities in the future to use it in education to help ESL students in their quest for academic and professional success. By considering the problem statement and gap in the literature, this study proposed a conceptual framework given in Figure 1.

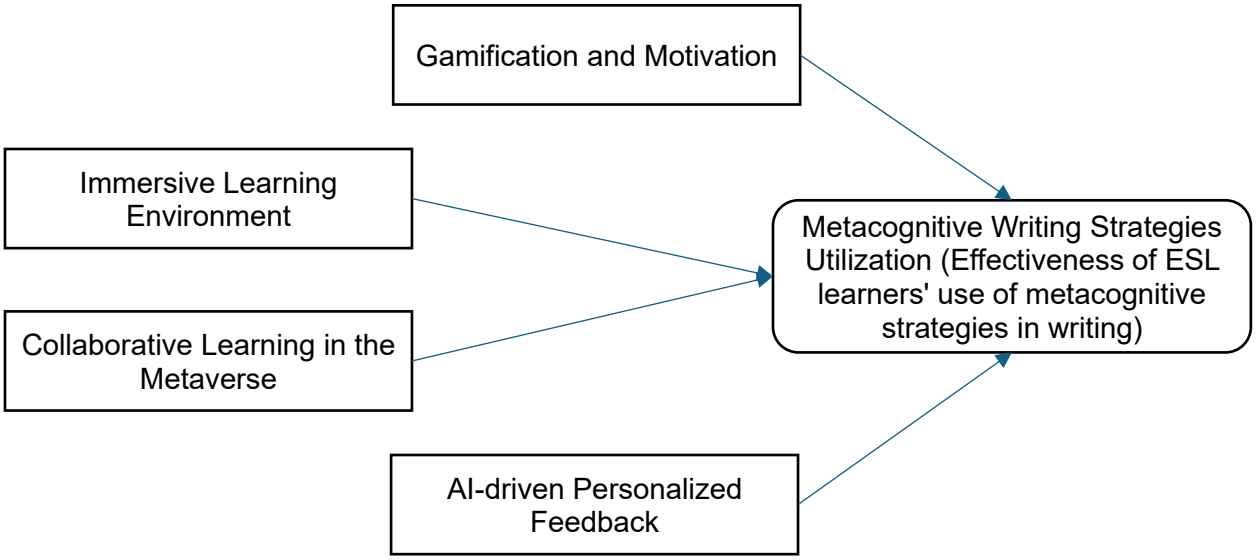

Figure 1: Conceptual Framework of the Study.

LITERATURE REVIEW

The Role of Immersive Learning Environments in Enhancing ESL Learners' Metacognitive Writing Strategies

The rapid development of digital technology has changed education practice (Austen et al., 2016; Galanaki et al., 2019; Ganaie et al., 2014; Walden et al., 2020), specifically the use of Immersive Learning Environments (ILEs) in the Metaverse. Another common immersive learning approach is the use of virtual learning environments which

are dynamic, interactive and engaging learning spaces that significantly enhance ESL learners' self-regulated learning ability and metacognitive writing skills (Mei et al. Throughout this interactive experience, ESL learners were able to cultivate and practice skills associated with critical thinking, self-monitoring, and reflective writing, resulting in increased autonomy and proficiency in academic writing. Metacognitive Writing Strategies: the three most important skills (planning, monitoring, evaluating). Through the use of virtual simulations and AI-driven guidance, ILEs assist learners in regulating their writing processes. Conversely, Metaverse-based virtual writing labs can from interactive prewriting activities whereby students can noodle out ideas, create outlines, and conceptualize organizations even before they sit down to write their composition essays. These activities aid the planning stage by prompting students to sketch out their arguments and define writing objectives.

Additionally, the real-time interactive feedback within the Metaverse allows learners to actively track their writing progression. AI-based writing assistants offer real-time feedback on grammar and coherence, while virtual peer reviewers assess argument structure and logic, helping students to self-regulate their writing process and improve in an iterative way. The constant monitoring complements metacognitive strategies by allowing learners to detect mistakes, revise plans, and promote clarity in writing. These activities you list also sound great to me, but it suspect that one of the most difficult thing in ESL writing is motivation (Sabti et al., 2019), and how to keep at it over a long spells of time. Writing classrooms in the traditional sense of artificial “writing spaces” seem more like vacuum tubes where learned metacognitive strategies never see the light of day. Although motivation and persistence can be a challenge in any learning scenario, external structures in ILEs, such as writing challenges, virtual rewards, and storytelling simulations, can also be implemented in a way that increases motivation and persistence. When learners are actively engaged in immersion writing activities — dressing up as a historical figure to write reflective essays or working over the web on digital storytelling projects — they become much more interested in their writing progress. This increases the need for metacognitive skills in self-discipline and goal-setting.

Writing is a full content area in ESL for good reason. As AI-powered adaptive technologies can customize writing exercises according to learner needs (Chen et al., 2020; Kim & Park, 2017), the Metaverse provides personalized learning experiences. NLP tools in virtual spaces parse writing styles of learners and suggest specific areas of improvement, whether in terms of coherence, argumentation, or lexical variety. Such adaptive learning environments encourage students to reflect on their progress which further helps them evaluate and modify their writing techniques. The more sharing and mutual-influence that can occur in the classroom, the more success with metacognitive writing strategies can be nurtured. The Metaverse creates virtual writing communities where ESL students collaboratively work on research papers, discuss essay topics, and attend interactive workshops. These provide opportunities for self-regulation, reflection, and knowledge construction in a way that enables learners to improve their writing strategies through constructive interactions. Immersive Learning Environments in context of ESL writing education for enhancing metacognitive writing strategies. The Metaverse

facilitates effective self-regulation of writing processes by providing interactive and immersive learning spaces, offering real-time feedback, gamified engagement, personalized instruction, and opportunities for collaborative writing. Consequently, ESL students develop confidence and independence, which allows them to become successful writers and thus ensure their academic success.

Collaborative Learning in the Metaverse: Enhancing ESL Learners' Metacognitive Writing Strategies

Teaching ESL learners metacognitive writing strategies is important as it allows them to self-regulate their writing process, reflecting on their goals and planning their writing (Al-Jarrah et al., 2019; Pitenoee et al., 2017; Razzaq, 2020; Tabrizi & Rajaee, 2016). Nonetheless, the interactive and dynamic components necessary for fully involving students in the learning process are all too often deficient in traditional learning environments. A new and innovative way to improve ESL learners writing skills is the use of the Metaverse, a virtual environment for interactive and cooperative learning. It creates opportunities for real-time social interaction, peer feedback, and collaborative writing among students, and significantly enhances metacognitive writing strategies through collaborative learning in the Metaverse. This is a creative workspace where students acquire more control of their writing, and through this innovation, they become better, more self-sufficient editors, taking ownership of their writing process.

Literature describe metacognitive writing strategies as a recursive process comprising planning, drafting, monitoring, and evaluating ones writing (Forbes, 2018; Goctu, 2017). The Metaverse advances this process further because it provides a rich, interactive environment for learners to work collaboratively on writing assignments, exchange ideas, and give and receive immediate feedback. In online classrooms, ESL students can participate in writing workshops, group discussions, and brainstorming sessions, which help them process and organize their ideas before they start writing. Live peer review and instructor feedback not only expands learner knowledge around their own writing strengths and weaknesses, but also provides them with the opportunity to devise strategies to improve their anticipated weaknesses.

Working with peers in a shared digital environment is one of the most important benefits of collaborative learning in the Metaverse. Virtual writing labs enable students to coauthor essays, discuss ideas and critique one another's work, creating shared accountability and encouraging one another. Typical learning models where learners have numerous collaborative learning activities that lead to an enhancement of conscious awareness of their thought processes, make them better planners, organizers of information, and achievers of logical thinking. Also, talking with peers about this writing strategies enables them to articulate their thinking and understand the metacognitive strategies more clearly so they apply this knowledge in later writing situations.

In collaborative learning, peer feedback is a vital element, and this action becomes more dynamic and instant in the Metaverse. Traditional writing instruction is heavily dependent on teacher feedback, which is often delayed and not always sufficient for

students seeking to improve in real-time. In contrast, the Metaverse allows learners to get real-time feedback from their peers via virtual discussion boards, collaborative documents, and AI-supported writing assistants. That quick feedback process helps the students manage what they are drafting as they are drafting, with room for correction and polishing based on commentary. ESL learners acquire self-assessment skills. One of the many benefits of attending these live feedback sessions is the ability to critically assess their own writing. By making changes to their work based on peer feedback, they develop the self-monitoring skills so critical to success. In addition, peer review has the added advantage of prompting learners to renew their understanding of their writing from the perspective of different audiences, leading them to spot mistakes, reformulate arguments and progressively improve how language is used. Through this repetitive cycle of receiving feedback and providing it, they foster their self-assessing skill, which fortifies the metacognitive processes required for self-regulation.

Participants can use the Metaverse for immersive writing simulations, which allow ESL learners to develop planning and monitoring skills as they practice writing in a simulated environment. Creating writing assignments in virtual worlds can imitate real-life experiences such as writing news stories, formulating research papers, and engaging in workplace writing. These simulations provide real-life scenarios in which students need to use their writing skills in meaningful contexts. For instance, in a virtual journalism project, students could interview avatars, collect information and work together to write news articles. If they go through this process, they need to always consider how to organize their writing, if their arguments are running together and how the final draft that they publish is presented. By using what they learned in the classroom in tangible ways, students can internalize the metacognitive strategies at play. Likewise, virtual debate rooms challenge learners to formulate compelling arguments as well as take them down, as well as to improve their writing in light of the exchanges with peers—focusing their writing processes and allowing them to think critically about the topics at hand.

Gamification features like team-based writing competitions, storytelling quests, and competitive writing challenges ensure an interactive ecosystem that engages students. Writing tasks are distributed in a machine-based manner in the students learn together in these engaging and nurturing environments (Amiramini et al., 2015; Karlen, 2017; Xin et al., 2020). Students who work in clusters develop a stronger sense of investment in their writing. Leaderboards, badges for achievement, and other virtual rewards to academic effort encourage the students track their progress and to strive for increments on their previous achievements. By engaging in these activities, they are inevitably self-evaluative and reflective, sharpening their ability to control their writing strategies. Furthermore, role-playing activities and narrative development assignments encourage ESL students to engage with creative storytelling, emphasizing the need for organizing plot lines, developing characters, and creating a logical flow. Not only do these activities help them learn to better structure and order their ideas, but also help them become more mindful of patterns in language and decisions made about word choice. You have to engage in this process, because play is how writing becomes a space for learning, and not a space where the assignment needs to be done.

Through virtual international writing communities, students can compare varying structures or styles of writing and adapt their own writing strategies based on a global perspective. Learning with peers from diverse linguistic backgrounds helps students consider how different audiences will respond to a piece of writing in terms of how formal it is, or how arguments are constructed. This exposure expands their horizons and makes them more flexible in their writing, planning and evaluating. Also, peer-to-peer projects which necessitate the use of multiple languages stimulate ESL users to pay attention to grammar, syntax and coherence. When they work with peers who have diverse linguistic strengths, students become more adept at evaluating their own writing and implementing strategies to improve clarity and fluency. Negotiating meaning within a cohesive virtual space encourages their self-monitoring and writing strategies refinement.

Additionally, collaborative learning within the Metaverse represents an innovative approach to improving metacognitive writing strategies for ESL students. These include peer feedback, social interaction, immersive simulations, gamification, and cross-cultural collaboration, all fostering critical thinking, self-regulation, and strategic writing skills to develop as the students themselves. Learners are actively engaged in birds eye view where the Metaverse is able to provide a dynamic, supportive, and interactive environment thus allowing their writing experience and outcome be far better than typical writing. By encouraging cooperative learning and self-reflection, the Metaverse helps ESL learners gain confidence as autonomous writers, ultimately enhancing their academic and professional writing results.

Gamification and Motivation: Enhancing ESL Learners' Metacognitive Writing Strategies

Motivation is a pivotal factor in learning a language with writing posing a challenge for ESL students in terms of engagement, self-regulation, and strategic thinking (Amiramini et al., 2015; Teng & Zhang, 2018). Such strategies must be sustained efforts, and also require cognitive energy and engagement. Many English as a Second Language (ESL) learners find traditional writing exercises tedious, which can reduce their motivation to apply metacognitive strategies properly. Gamification has come to support more interactive and enjoyable learning atmosphere and improves the motivation and stimulates the students to follow self-regulated writing behavior.

Gamification then makes writing far more than a rote task by including things like incentives, digital competitions, challenges, and interactive storytelling to turn it into an experience. With this enhanced motivation, we see a greater adherence to meta cognitive strategies where learners are more aware of their planning, self-monitoring and reflection as they write. The combination of gamification and motivation gives ESL learners the desire to engage more in-depth with writing tasks, which in turn results in an increase in metacognitive writing strategy. Even in one's own language, writing takes time, energy and brain cycles to put into practice. Grammar, vocabulary, and ideas — oh my! [They are] the three most common sources of anxiety and frustration for ESL learners. Gaining levels, points, and unlocking writing challenges or rewards gives students the sense of achievement that contributes to intrinsic motivation and makes students more likely to

actively engage with writing.

In addition, competition and cooperation in gamification learning contexts help to maintain motivation. Team-based writing competitions, and stakes provide motivation for learners to git along writing better (Graham et al., 2019; Hasbollah, 2010). Using gamification through social components so that students can see their progression compared to friends, or work together on writing projects helps to create a sense of community and responsibility. This entices them to plan their writing with more detail, track their progress, and check their work against the feedback—where the metacognitive writing strategies reside. Using rewards to reinforce positive learning behaviors is one of the most effective aspects of gamification. Without being acknowledged for their hard work in a traditional writing classroom, students may become apathetic to the process. Gamification, on the other hand, provides immediate feedback and reinforcement via badges, points, and virtual rewards. This means that students are more motivated to go deeper into their writing and to actively engage the process of applying metacognitive strategies. For instance, if an ESL student follows a plan for writing preparation, and successfully completes that process before drafting, they could be awarded a progress badge. This validates planning as a metacognitive strategy and provides students with behavioral feedback to replicate that behavior in follow-on writing tasks. Conversely, students who engage in ongoing self-monitoring by revising drafts according to AI-generated commentary or peer feedback may receive greater scores or unlock additional writing challenges. By using game mechanics, these incentives over time establish habitual use of the metacognitive writing strategies, naturally integrating them with the learner's writing process.

In addition, gamification creates a safe space for learning, so students are enabled to practice the skill of writing without the fear of failure. Traditional writing assessment tends to emphasize correctness as opposed to creativity or risk-taking — nothing new, and nothing risky. In a gamification scenario on the other hand, learners are motivated to iterate their work through repeated attempts, and they get feedback in the process too. The repeated cycle reflects the self-regulation aspect of metacognitive writing strategies (Al Moqbali et al., 2020; Stewart et al., 2015), in which students analyze and enhance their writing. Interactive storytelling is an important element of gamification that reinforces motivation and encourages the use of metacognitive strategies. Insert gamified learning environments as opposed to generic writing prompts which insert students into narratives where writing decisions shape a story's outcome. This method turns writing into a purposeful and exciting task where students are eager to plan their responses well, consider their language carefully and assess the effectiveness of their writing.

An ESL learner, for example, may role-play in a virtual environment with the perspective of a journalist, detective or historian. In these roles, they write investigative reports, solve mysteries through written arguments or craft historical narratives. The gamified narrative lends itself well to the inherently metacognitive nature of collecting ideas, outlining, and revising drafts. Since their writing performance will determine the outcome of the game, students are likely to engage in deeper cognitive processing than their writing would otherwise be coherent, structured, and within the coach's space of intention. Moreover, gamified storytelling brings in the aspects of adaptive feedback too.

Immediate feedback in a gamified environment encourages students to self-monitor and adjust as they are writing, unlike static classroom correction, which can be days from submission. Such real-time engagement enhances their writing process regulation (Amiramini et al., 2015; Teng & Zhang, 2018; Xin et al., 2020), supporting metacognitive strategies of self-assessing and revision. In addition to intrinsic motivation in the short term helped by gamification, in the longer term the technique supports the development of writing autonomy and self-regulation. With game-based learning, students channel their energy into controlled progress, setting their own goals and mapping their journey to achievement. This is due to the fact that overall many gamified writing platforms utilize progress dashboards that allow learners to track and visualize their progress over time. This also helps establish a growth mindset, where learners understand that excellence in writing comes from hard work and intentional practice.

Also, gamification encourages the persistence of writing. Thousands of ESL learners quit any writing activity for frustration or lack of confidence (Fareed et al., 2016; Razzaq, 2020). When writing is integrated into a gamified setting, though, learners see challenges as opportunities rather than roadblocks. They are more open to trying out different writing styles, revising their material a few times, and getting feedback to help improve their skills. Such resilience resonates with metacognitive writing strategies in which students actively engage in the triadic cycle of planning, monitoring and revising their work towards writing success. Gamification is also well adapted to individual learning styles. Instead of a traditional classroom setting, where students are expected to go through the same curriculum, gamified learning platforms encourage individualized writing challenges. Base ESL practice on a identify prior organizational needs to aim practice for organization — perhaps, those needing help organizing an paragraphs may get specific exercises outlining support, or those struggling with grammar might get help with sentence structures. This ensures that learners cultivate metacognitive skills and develop reflective practices around their unique writing situations.

Gamification as a motivational tool for ESL learners developing metacognitive writing strategies They take the writing process to the next level then gamify it using measures like: game-based rewards, interactive storytelling and adaptive feedback. Greater interest in writing, in turn, promotes continued use of metacognitive strategies, allowing writers to plan, monitor, and evaluate their writing more effectively. It also helps to develop autonomy, resilience, and self-regulation that facilitate long-term writing success. Gamification not only enhances ESL learners' motivation by making the writing process more dynamic and interactive but also allows the metacognitive writing strategies to be an integral part of ESL learners in academia and career advancement.

AI-Driven Personalized Feedback: Enhancing ESL Learners' Metacognitive Writing Strategies in the Metaverse

AI-enabled educational tools have revolutionized the approach to writing instruction, an evolution with roots in the late 20th century (Hadi et al., 2015). Writing skills for ESL students is distinguished by the necessity to put into action metacognitive strategies like planning, monitoring, and evaluating written work. What have been the

implications of this limited feedback, delayed corrections, and the absence of personalized guidance, particularly for students who always do well in school, but struggle with self-regulation? In the context of the Metaverse, AI-driven personalized feedback aligns with this need by delivering on-the-spot, adaptive, and student-specific writing support. Such AI-driven feedback mechanisms allow learners to calibrate their writing processes — ultimately fostering self-monitoring and strategic planning in their writing.

The Metaverse provides an immersive and interactive learning experience (Dionisio et al., 2013; Hadjistassou, 2016) by harnessing AI technologies like natural language processing (NLP), automated scoring systems, and adaptive writing tutors. Generating metacognitive skills: AI-powered feedback promotes the development of metacognitive skills through its continuous, specific, and contextualized comments that promote deeper engagement of ESL learners with their writing. As a result of this process, learners are not only more cognizant of their strengths and weaknesses, but also able to self-control their writing strategies, thus leading to an increase in their writing ability. One hallmark metacognitive writing strategy, most connected to the present, is self-monitoring, which consists of the continual assessment of one's progress while writing. Such a skill is not effectively supported by traditional feedback mechanisms, where students typically receive feedback only after they submit their work. Feedback on writing from AI machine-learning approaches on copy submissions in the Metaverse bypasses this limitation, providing instantaneous, continuous processing of learners' writing every step of the way. Students gain immediate feedback on grammar, sentence structure, coherence, and appropriate word choice through AI-enabled writing assistants.

For instance, when a student writes an essay in a virtual writing lab, AI tools analyze their text in real time, highlighting errors and suggesting improvements (Masferrer et al., 2014). Rather than merely waiting for an instructor's feedback, the student engages actively in the process of self-correction and learns to see patterns in their writing. By prompting students to think about their writing decisions and adjust accordingly, this process reinforces self-monitoring. Of course, after going through numerous rounds of interacting with AI feedbacks over time, they really begin to internalize principles of good writing and rely less on being corrected, developing more autonomy over developing their writing. In addition, AI feedback explains the proposed revisions and not just correcting the errors. It provides feedback with sufficient detail in order to contextualize specific aspects of the writing to enhance the learner's understanding (and engagement) with metacognition by explaining why those particular aspects are an issue. As students become more familiar with reading and interpreting AI-generated feedback, they will also become better at self-assessing their writing and taking the initiative to address weaknesses without necessarily waiting for someone else to point them out.

Writing is a domain with great depth and breadth to its beautiful, intricate, unique form that also demands as careful planning and for ESL learners even more since they have to grapple with issues that arise from organizing ideas, the logical, coherent flow of argument and sufficient language to express it all clearly. Metacognitive writing strategies are also well supported through AI-driven writing tools in the Metaverse, which provide strategic scaffolding for sketching, brainstorming and structuring content. In contrast to

traditional writing instruction that may ask students to create clear writing plans with little external support, AI-based tools can help scaffold students' thinking to help them plan strategically (Kim & Park, 2017). For example, AI-powered brainstorming assistants spit out topic ideas, recommend thesis statements and provide templates for organizing essays. As an ESL learner engages in a writing task, AI systems can show them how to create an outline of relevant arguments, persuade them on how to segregate the content into paragraphs and ensure that it is progressing logically. Also, as students interact with these tools they begin to predict writing problems and it's more likely to plan as a metacognitive strategy and pre-planning their responses before writing.

Furthermore, adaptive AI writing assistants can customize planning suggestions according to a learner's past writing patterns. If a student consistently gets low coherence scores, the AI might advise that they develop their paragraphs in stages, making sure the lines are meaningfully connected. If the other student struggles to develop their argument in a cohesive way, the AI can guide them with lecture style prompts to help substantiating the reasoning and evidence based elaborations. It enables them to highlight what area of plan they need focus more on and therefore make planning a more natural part of the writing process rather than an afterthought as they strive to get everything in order before writing (Conner, 2007; Teng & Zhang, 2018; Xiao, 2007). Metacognitive writing strategies use reflection and revision in writing, enabling learners to improve their work through feedback. Metaverse provides AI-based personalized feedback that allows students to connect their work and realize better ideas what they need to revise, and also they will see their own ideas how connected and coherent they are through the writing ideas they connect through suffered way. Traditional methods of supervision, in which we may be unclear about the feedback we provide or time it takes until a student receives such feedback, do not allow for the level of immediate reflection we see with AI tools, which offer comments on grammar, coherence, word choice, and grammar mistakes in real time.

AI-powered platforms, for example, can identify nonlogical reasoning, missing thesis statements, and awkward phrasing, giving students reactive, step by step feedback to improve their writing. These tools typically provide revision tracking features that help learners compare multiple drafts and see their progress over time. These visualizations helps students develop awareness of how revisions improve clarity and coherence — elements that are strengthened by reflection in writing. Metacognitive engagement is also furthered by AI-driven peer review systems that allow for collaborative revision. AI tools help analyze and synthesize comments made by peers in the Metaverse, where ESL learners can receive AI-moderated feedback. This opportunity for focused feedback exchange allows students to see their writing through multiple lenses, making their revision process grounded in informed and productive feedback. Thus, the practice encourages repeated self-check and evaluation cycle leading to a more strategic and autonomous writing habit. One of some ESL learners biggest challenges when it comes to writing is confidence (or more the lack of it) which is often caused by unclear feedback or repeated mistakes. AI-generated personalized feedback solves this problem by establishing a supportive and non-judgmental low-pressure learning environment, in which students are allowed to make mistakes. AI-generated feedback is immediate, and

its low-stakes nature can promote experimentation with writing and cultivate a growth mindset among learners.

However, students who receive AI-assisted feedback that considers improvements, points out strengths as well as areas for improvement experience a higher level of motivation to respond to the writing procedure. Many AI writing assistants have gamification components built into them, such as achievements for completing edits or dashboards that visualize progress toward becoming a better writer. Being a motivational device, these tools help embed persistent and resilient writing in students doing distant metacognition, with the likelihood of recursive performance of metacognitive strategies being adopted over the long term. Moreover, such AI-led platforms also provide an interface for the learners to set a target writing goal and monitor the progress over time. Students receive customized suggestions for improvement and insights into their writing process, empowering them to take ownership of their writing and strengthen their resolve to improve. Being able to measure progress not only gives experience but it also fosters the practice of metacognitive writing strategies outside classroom contexts.

The impact of AI novel personalized feedback in metaverse on ESL users metacognitive writing strategies. However, by offering immediate and contextual feedback, the AI tools encourage self-monitoring, allowing students to learn more about their strengths and weaknesses as writers. AI writing assistant tools facilitate a more methodical and strategic approach to writing; they reinforce the need for writing to be organized and planned. In addition, AI-based revision recommendations foster reflective thought and iterative enhancement, which enhance the organization and efficacy of the revision process. In addition to the enhanced technical advantages, feedback from technical AI, fosters the motivation and self-confidence of learners, enabling them to create in a safe environment without the fear of failure. ESL students internalize and apply metacognitive strategies effectively, thanks to the combination of personalized guidance, interactive revision tools and gamified motivation mechanisms. With AI technology progressing in the Metaverse, its application will remain central to the evolution of writing lessons, leading to a generation of autonomous and strategic writers.

CONCLUSION

The integration of AI-driven personalized feedback in the Metaverse represents a significant advancement in ESL writing instruction, particularly in fostering metacognitive writing strategies. Pre-writing in the second language is a very complex cognitive task, because it needs writing learners, as the second language writers, to do attentiveness to their writing in the process of planning, monitoring and re-writing. Traditional methods of writing instruction often underestimate the need for on-demand, personalized, and systematic guidance, which is a major obstacle for learners needing to cultivate self-regulatory capacities. AI-driven feedback systems mitigate these publication challenges with real-time, adaptive and personalized support, directing ESL students toward better writing practices.

AI improving metacognitive writing strategies through self-monitoring One of the

most powerful ways AI advance metacognitive writing strategies. AI-based writing assistants can evaluate student work in real time, flagging mistakes in grammar, coherence, and organization, as well as offering extensive explanations and tips for improvement. Traditional feedback is often delayed and generalized; compared to that, AI provides immediate, context-specific feedback that prompts students to think critically about their writing decisions. This practice nurtures a culture of self-evaluation, allowing students to develop ownership in recognizing and addressing areas for improvement where they may be lacking. By then, as students encounter feedback produced by AI repeatedly, they learn strong writing structures well enough to assess their own progress and improve their writing independently.

Moreover, AI in the Metaverse tools help students enhance their ability to write strategically. This task is often not easy for ESL learners, who have to develop all these skills in English – struggling with structuring thoughts, organizing ideas, and crafting logical flow. AI-supported brainstorming and outlining tools offer a structured guide by prompting each student with topic and thesis ideas as well as paragraph outlines. By providing this tailored support, students are prompted to view writing as a process that requires strategic thinking: a well-thought out plan produces greater clarity in their writing. This principle gives you a mindset that, thanks to AI-powered feedback, makes planning an inextricable part of writing and not just an afterthought.

AI function in shaping reflection and revision is equally revolutionary. Writing is an iterative process that requires several revisions, but many ESL learners cannot identify weaknesses in their writing without the help of a teacher. AI-powered feedback provides well-organized suggestions during revision, guiding students in strengthening their arguments, clarifying their points, and improving clarity and coherence. AI-powered platforms allow us to see multiple drafts and track progress, serving as a powerful reminder to use revision as a metacognitive exercise and build our drafts over time. Yet, AI-assisted peer review systems act as second layers for novice and competent learners as it allows them to reflect on the feedback on their deliverables, and helps them in improving their skills of self-evaluation and incorporating the suggestions from people around them. AI writing tools provide collaborative feedback capabilities, which encourages users to engage with writing in a way that makes the revision process engaging, practical, and constructive.

AI-driven feedback also contributes significantly to motivation and confidence, which are essential drivers of writing success among ESL students. When faced with writing challenges, however, many students become anxious and frustrated, especially when feedback is vague or just too much to handle. AI-driven platforms foster a safe, encouraging space for learners of all levels to play with the written word, receive positive feedback, and monitor their performance almost immediately. Gamification aspects from up on high like achievement badges and progress tracking dashboards promote motivation by prompting writers to set goals and continue working to improve their writing skills. Overall, through a process that encompasses immediate feedback, structured guidance, and motivational reinforcement, students find themselves continually engaged in the learning process, and metacognitive writing strategies become the natural, habitual

part of their writing development.

The use of AI-powered personalized feedback in the Metaverse reflects a move towards a more self-directed, reflective, and self-regulated model of writing instruction for ESL learners. AI strengthens learners' ability to assess, plan, and revise their writing — through immediate, targeted and interactive feedback. And the feedback we provide through AI is uniquely personalized, so we can continue to guide learners and help them to think more deeply about writing as a cognitive and strategic process. Improved motivation from AI-powered platforms also encourages students to stick with writing longer, and incentivizes them to apply metacognition techniques into their situations outside the classroom.

The future of ESL writing instruction in the key will be limited by our imaginations after many more years of growth of AI technology and its capacity in the ESL writing instruction field. AI is used here to provide timely and constructive feedback on the content and structure of written pieces, and because a lot of writing takes the form of step-ups through intuitive reception with AIs that generate essays as needed, the Metaverse offers a particularly apt area to combine immediate written feedback and other aspects of user interaction into an enriched simulation that provides varied pathways through the immersive, interactive, and personalized learning space that makes up the writing process. As technology advances, AI-generated personalized feedback will continue to empower ESL learners to guide their own writing growth, leading them to become self-sufficient, thoughtful, and independent writers.

IMPLICATIONS OF THE STUDY

The implications of these study findings can have strong implications for educators, policymakers, and technology developers interested in supporting ESL learners to enhance their written proficiency by receiving individualized feedback via AI technologies in the Metaverse. The use of AI in writing instruction provides a new approach to teaching the metacognitive strategies of writing that should encourage learners to be independent in monitoring, planning, and revising their writing. Utilizing AI-based feedback can provide personalized, immediate assistance to ESL students, encouraging self-regulated learning that can enhance writing quality.

For educators, simply recognizing this tendency of students toward AI-driven technologies makes it clear that such tools would need to be part of writing curricula to promote metacognitive strategy use. Traditional writing instruction often relies on delayed feedback which constrains learners in developing self-monitoring and planning skills. However, with the help of AI-generated feedback, immediate and targeted support can be used to help guide learners to ongoing reflection on their writing. Developing data-informed instructional strategies that leverage AI writing assistants and adaptive feedback mechanisms allows teachers to weave new technologies into classroom activities that support unique student needs and continuums.

For policymakers, the study gives important implications that investing in the AI-

enhanced education technologies will be promising for the improvement of the ESL writing instruction. To address this issue, governments and educational organizations need to invest in the development of adaptive AI-based learning platforms to accommodate different linguistic and cognitive needs. In the Metaverse, the arrival of AI-powered feedback tools enables vulnerable learners to bridge learning gaps; for example, ESL students can benefit from personalized learning experiences that the physical classroom lacks.

For developers of technology, the research demonstrates the opportunity that AI-powered feedback systems can ultimately progress into adaptive learning experiences that provide users with enriching learning experiences. With the help of natural language processing (NLP) and machine learning algorithms, developers can train AI models to offer deeper insights about students' writing patterns and personalized recommendations. Integrating even more interactive and gamified components within AI platforms would further engross learners, encouraging them to be resilient to work on the development of their writing strategies. In conclusion, this study bridges a gap in the literature by identifying the possibilities and challenges of integrating AI in developing metacognitive writing strategies among ESL learners and encourages collaboration between educators, policymakers, and technology developers in this domain.

LIMITATIONS AND FUTURE DIRECTIONS

This study is valuable in how it provides conceptual insight into the role of AI-driven personalized feedback in the Metaverse to help ESL learners support their metacognitive writing strategies. But its theoretical character does impose some constraints. A key limitation is the lack of empirical testing. Since this study is not based on survey data or experimental results, its suggested implications should be seen as speculative and must be verified whether they work in practice at educational institutions. Future studies need to be qualitative and quantitative in order to measure the effect of AI feedback on the writing development and metacognitive engagements of ESL learners.

Another restriction is due to the evolving nature of AI technology itself. Technology is never stagnant, this covers AI-driven feedback control mechanisms, need intermediate level Natural Language Processing (NLP) models, and adaptive learning models. In particular this study concerns the You can write AI-powered writing tools available today, but future generations of AI will likely provide even more advanced writing features, including deeper context awareness, emotional feedback, and multimodal writing guidance. Future studies should investigate the extent to which such development facilitates the use of metacognitive strategies in ESL learners. There are also efforts to study ethical and pedagogical challenges associated with AI-driven feedback that are not addressed in this study. Data privacy, algorithmic biases, and over-reliance on AI tools are some of the issues that need thoughtful consideration. Although AI delivers instant and customized feedback, over-reliance on technology can diminish learners' critical thinking and decision-making in their writing. Further research should explore the processes required to combine AI support with teaching, ensuring that students continue to develop writing skills independently rather than relying entirely on artificial feedback.

Further studies should explore how learner profiles (e.g., proficiency level, culture, cognitive style) will moderate the effectiveness of AI-driven feedback. The need for diversity in AI tool personalization. Empirical research that contrasts the impact of AI-driven feedback versus traditional instructor-led feedback would enhance effectiveness in determining the most beneficial utilization of AI within ESL writing instruction.

Moreover, since the Metaverse is immersive and interactive in nature, we suggest that future studies employ AI feedback within VR and AR environments. This blend of technology and immersive learning experiences is ever-evolving and may correlate with added engagement, motivation, and self-regulation in ESL writing. Longitudinal studies that investigate the long-term impact of AI-mediated feedback on learners' writing development will also be useful in evaluating its long-term efficacy. Nevertheless, this conceptual study enhances existing discussions on artificial intelligence applications in education and promotes the prescriptive potential of personalized feedback through Ais to enhance metacognitive writing strategies. Moving forward, it is essential for future work to translate the theory into practice via empirical studies, improving AI models, and addressing pedagogical and ethical concerns to best apply the advantages of AI to ESL composition instruction.

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