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Exploring the potential and implications of digital tools in teaching academic writing

Abstract: This study employs a systematic literature review to explore the pedagogical potential and implications of integrating digital tools into academic writing instruction. The review synthesises empirical and theoretical studies, with the purpose of examining how digital feedback mechanisms, such as automated writing evaluation systems, artificial intelligence-powered assistants and multimodal platforms affect writing proficiency, support personalised learning and promote inclusive practices. The findings reveal that digital tools enhance surface-level accuracy, engagement and revision habits. However, their effectiveness is highly dependent on how they are thoughtfully integrated into teaching, customised for students' needs and used to address ethical and equity challenges. This paper also investigates critical concerns, including academic integrity, algorithmic bias and the risk of overreliance on automation. Ultimately, the study underscores the importance of thoughtful integration, digital literacy and teacher guidance to ensure that the support provided by digital tools to improve academic writing development is fully maximised.

Keywords: digital tools, academic writing instruction, educational technology, systematic review

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Introduction

Academic writing has undergone significant changes in tertiary education with the emergence of digital technologies. Traditionally, the teaching of writing relied on face-to-face instruction, manual feedback, and passive classroom practices (Sim & Ling, 2025). Although these approaches provided essential support in the classroom, they failed to meet the diverse expectations of modern learners and the growing demand for efficiency, individualisation, and engagement. That can be used to enhance the acquisition of writing skills and to develop personalised learning, such as automated writing evaluation systems, AI-assisted writing platforms, collaborative online tools, or multimodal composition software (Nunes et al. 2022; Strobl et al. 2019; Song and Song 2023).

The incorporation of technology in teaching academic writing provides room to deal with the linguistic and cognitive aspects of writing. Specific resources, including AI-based feedback, provide immediate, focused feedback about grammar, syntax, style and argumentation while also allowing learners to undergo repeated revision cycles and learn language norms better than delayed feedback models (Zhai and Ma 2023; Chen and Gong 2025). Popular collaborative tools, such as Google Docs, Notion and AI-enhanced brainstorming tools, enhance interactions between peers, improve co-authoring and facilitate shared reflections, thus promoting the learning process in which students can negotiate meaning, receive various options and refine their writing throughout the process (Imran and Almusharraf 2023; Aull 2020). Multimodal composition tools combine writing with visual, audio and interactive features to support the academic communication of secondary and tertiary students in the 21st century (Anderson et al. 2020; Rasyid et al. 2025; Kachorsky 2019). Nevertheless, their use brings some ethical issues about authors, equal AI access and critical and ethically based teaching (Khampusaen 2025).

Equally, although digital resources can successfully boost motivation and engagement, they can also partly replace the more digital-savvy or more stable-access technology-dependent students, who could also impact a level of inequality in the achievement of their goals (Nguyen 2025; Strobl et al. 2019). These beliefs

emphasise the importance of evidence-based strategies of integration, instructional supportive technology and the ongoing enhancement of professional growth in educators. Thus, with technology, the quality of the pedagogical process can be improved instead of worsened.

This systematic review aims to present a synthesis of current empirical and theoretical studies on the implementation of digital tools in academic writing instruction in higher education. In particular, this study aims to offer detailed information regarding the opportunities and challenges related to digital writing instruction by analysing the impacts of technology on writing proficiency, personalised learning, inclusivity and pedagogical ethics. The results aim to empower teachers, policymakers and curriculum developers who may want to use technology effectively without compromising the rigour, equity and ethics in educational programmes (Tran 2025; Sutrisno et al. 2025; Strobl et al. 2019).

Based on its principles, a 'systematic literature review' (SLR) is defined as a review with a well-defined purpose, question and a clear search strategy. It is often accompanied by a clear mention of inclusion and exclusion criteria, and the output consists of a qualitative appraisal of the articles. The current review prefers this method over the use of a traditional narrative review to achieve rigour, transparency and replicability in the process of identifying and synthesising relevant research. The key objective of this study is to answer the following research questions (RQs):

– RQ1. How do digital tools influence writing proficiency, and how do their effects differ across tertiary educational levels?
– RQ2. How do digital tools facilitate personalised and adaptive learning experiences in academic writing instruction?
– RQ3. What are the key pedagogical and ethical challenges associated with integrating digital tools, and how can they be mitigated to foster inclusive and equitable learning environments?

This article synthesises current research findings from an SLR to explore the multifaceted impacts of integrating digital tools into academic writing instruction. The results section examines in detail how these technologies influence writing proficiency, support personalised learning and address the needs of diverse learners in various educational contexts. It also critically addresses the inherent pedagogical tensions, ethical considerations and equity implications associated with their integration into contemporary educational practice, drawing on a wide body of literature to provide a comprehensive overview.

Methodology

Review Design

This paper used an SLR to appraise the effectiveness, promise and issues of implementing digital feedback systems and other digital resources in the teaching of academic writing. Furthermore, the review utilised PRISMA 2020 to raise the level of transparency, rigour and replicability. The SLR method has been selected in this work as it enables the systematic determination, assessment and thematic synthesis of the varied evidence based on various educational and technological situations.

Search Strategy

The search strategy was developed to thoroughly identify the appropriate studies in various databases and sources. The databases searched included ERIC, Scopus, Web of Science and Google Scholar, which were chosen because of their broad scope of search on educational and interdisciplinary studies. Aside from searches in the databases, the reference lists of influential articles, institutional repositories (e.g. CORE and ResearchGate) and conference proceedings of well-known educational technology symposia were checked to identify pertinent grey literature. All searches were performed between the months of March and June 2025, with the last search update done on 10 June 2025 to ensure that the most recent designs were included. The search query comprised the following keywords and Boolean operators: (digital tools) OR (technology) OR (AI) OR (automated feedback) OR (AWE) OR (digital writing) and (academic writing) OR (writing instruction) OR (composition) OR (literacy) AND (feedback) OR (proficiency) OR (engagement) OR (personalization) OR (diversity) OR (inclusion) OR (equity). The indexing systems of the individual databases were adjusted to minor syntactical adjustments. Then, filters were used to narrow down the results to peer-reviewed publications in English since 2019. There were no limitations in terms of geographic location or the level of education. Table 1 presents the database-specific search strategies and filters that were utilised during the search process.

Database / Source	Search String / Keywords	Filters & Limits Applied	Date Last Searched	Notes / Rationale
ERIC (Education Resources Information Center)	('digital tools' OR 'technology' OR 'AI' OR 'automated feedback' OR 'AWE' OR 'digital writing') AND ('academic writing' OR 'writing instruction' OR 'composition' OR 'literacy') AND ('feedback' OR 'proficiency' OR 'engagement' OR 'personalization' OR 'diversity' OR 'inclusion' OR 'equity')	Peer-reviewed only; English language. 2019–2025	10 June 2025	Captures educational and pedagogical research, including classroom-based studies.
Scopus	Same as above; syntax adapted to Scopus Boolean structure	Peer-reviewed; English; article and conference paper types. 2019-2025	10 June 2025	Features broad coverage of interdisciplinary education and technology studies.
Web of Science (Core Collection)	Same as above	Peer-reviewed; English 2019–2025	9 June 2025	Ensures inclusion of high-impact journals and cross-disciplinary studies.
Google Scholar	Same as above; phrase search applied for 'digital tools in academic writing'	Top 200 English results manually screened 2019-2025	9 June 2025	Captures grey literature and recently published works not yet indexed elsewhere.
CORE / ResearchGate (Institutional Repositories)	'digital feedback' AND 'academic writing' AND 'AI'	Open access; English 2019–2025	8 June 2025	Used to identify theses, preprints and working papers with pedagogical relevance.
Conference Proceedings and Institutional Reports	'AI-assisted feedback' OR 'digital literacy in writing'	English 2019–2025	5–8 June 2025	Ensures recent innovations and emerging tools are included.
Reference Lists / Citation Chasing	Manual backward and forward reference checking	No filters	Ongoing through June 2025	Used to capture additional relevant sources cited by key studies.

Table 1: Database-specific search strategies and filters

Inclusion and Exclusion Criteria

The inclusion criteria were as follows: the research must have (1) focused on digital tools or AI-based systems as they were used to teach academic writing; (2) described the comments on pedagogical, ethical, or equity-related effects of technology use; and (3) included publication in English by researchers within the period of 2019–2025. The exclusion criteria were as follows: non-academic or strictly technical studies that had no pedagogical analysis, duplicate entries, studies that

were irrelevant to the topic of writing instructions, studies with insufficiently described methodologies and those with inaccessible data. Due to the combination of these criteria, only explorations of interest deemed methodologically sound were considered in the synthesis.

Study Selection Process

The study selection process was based on PRISMA 2020. The records were imported into the databases under the Mendeley Reference Manager to remove duplicate records. The titles and abstracts were screened to arrive at potentially relevant studies, after which the remaining papers had to undergo a review of the full text. Duplicates and record management were identified by the use of automation tools built into Mendeley, although they were not used to make inclusion decisions. Of the 120 records in a sample, 40 were eliminated as duplicate records, 42 records were eliminated following the screening on titles and abstracts and 38 records were evaluated as possibly eligible. Following the complete-text analysis, 30 articles were included based on the criteria and were selected for the subsequent systematic review.
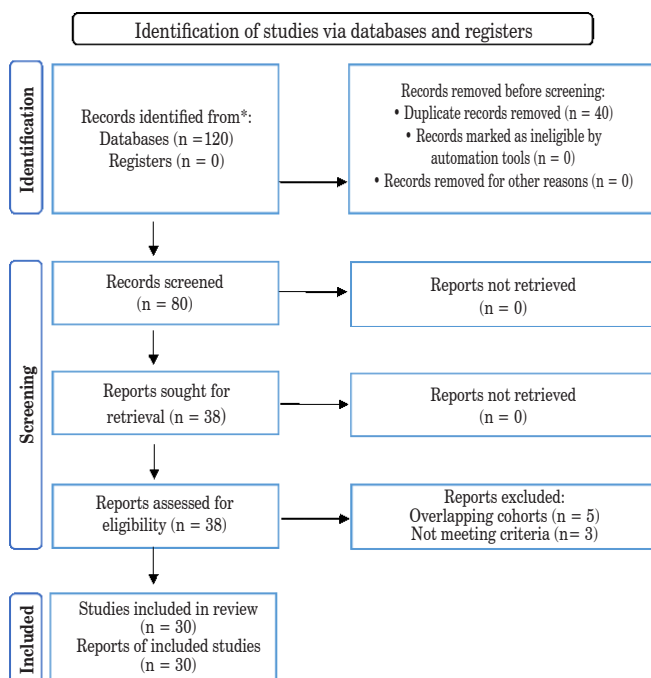

Figure 1. PRISMA flow diagram

Data Extraction and Variables

The extraction process was achieved by entering the data separately into an organised template in which information on bibliographic data, the study situation, educational level, participant features, the types of digital tool or feedback system was filled. In the same template, the pedagogical results were reported alongside ethical or equity-related likes or dislikes. There were no tools for automatically extracting data. In cases of missing or unclear data, contextual interpretation was made, and in a few cases, clarification was requested with the authors of the studies. The main metrics of interest were mastery of writing, involvement of learners, individualisation, inclusivity and pedagogical innovation. Amongst the secondary variables, sample characteristics, institutional context, tool design and source of funds were included, all of which were assessed to identify the potential impacts on the outcome.

Risk of Bias Assessment

A Critical Appraisal Skills Programme (CASP) checklist of qualitative and mixed-methods research was used and adapted to determine the risk of bias in individual studies. The assessment was extensively done with methodological rigour, transparency and credibility. As the review was qualitative in nature, the measures of the effect, such as the risk ratios or the mean difference, could not be used. Rather, results were explored by inductive thematic synthesis, with a specific focus on common patterns, relations and theoretical tendencies across studies. The thematic groupings of studies were based on the following focus areas: (a) improving writing proficiency, (b) the use of personalisation and adaptive learning, (c) inclusivity and equity and (d) ethical and pedagogical issues.

Data Synthesis and Analysis

The data were manually synthesised by extracting relevant quotes into matrices from evidence of interest and then coded. Afterwards, the matrices were combined. The use of thematic maps and visual tabulations aimed to demonstrate various digital tool types, educational settings and learning outcomes, thus enabling the analysis of heterogeneity through comparison with data. The aim of this step was to examine differences in regions, education levels and technologies using comparative thematic analysis. Again, to review the themes, all research papers with poor methodological quality were eliminated. Then, a qualitative analysis was conducted to assess the overall confidence of the synthesised evidence, determined by the study's quality, regularity of findings and consistency with theoretical concepts.

Results

The SLR confirms that the integration of digital tools has profoundly re-shaped writing instruction across educational levels in many, though not necessarily all, global contexts, thus marking a paradigm shift from traditional practices. In particular, the writing process now unfolds across dynamic digital environments, supporting diverse learners' needs and enabling interactive, iterative approaches to writing aligned with 21st-century literacies. The structure of this synthesis of findings is based on the following central areas of enquiry: the role of digital tools in terms of writing proficiency, their ability to support personalised learning, their ability to meet the needs of different learners and the substantial pedagogical and ethical tensions surrounding their use.

I. Improving Writing Skills via Digital Engagement and Feedback

As shown in recent studies, students have greatly benefited from AWE tools. These tools, comprising AI-driven assessment systems, have made writing much easier by giving learners prompt feedback about their work. Through the introduction of this tool, a great transformation has been witnessed in writing styles, boosting the quality of learning in higher education institutions. Consequently, the enhanced language output led to the production of high-quality written papers (Zhai and Ma 2023; Alharbi 2023; Tran 2025). These tools, including but not limited to grammar and spell checkers, complex AI-powered writing assistants, and so on, mediate the various parts of the writing process and enable learners to experience learning via self-assessment and self-reflection without the need for a constantly present human instructor (Agrati and Beri 2025; Fan and Ma 2022). The timeliness of the digital feedback also means that the students are able to identify the errors, recreate sentences and improve vocabulary use on the spot, which in turn leads to short-term performance improvement and long-term improvement in writing fluency (Nguyen 2025; Pitukwong and Saraiwang 2024). This on-demand correcting ability and guidance correlate with the pedagogical aim of producing independent, self-regulated students who can cope with challenging writing tasks in various academic settings.

Digital platforms are also essential in increasing tertiary students' rhetorical awareness and argumentation skills. The chatbots such as ChatGPT and ProWritingAid that are readily available to help students draft a writing assignment help them format their arguments, brainstorm ideas and follow the conventions of a particular discipline, which are fundamental features of academic writing (Song and Song 2023; Khampusaen 2025). These tools also allow the students to learn how to structure their ideas logically, elaborate ideas via coherent paragraphs and communicate with the audience's requirements by giving modelling examples and scaffolding with the help of the interactive prompts. Moreover, collaborative writing technology integration facilitates knowledge co-construction, allowing learners to share ideas, comment on one another and polish the content,

thus bringing additional AI assistance benefits to writing resources aside from the individually assigned writing tasks (Imran and Almusharraf 2023; Aull 2020). To a greater extent, this type of AI assistance and the collaborative interactions it generates are favourable for cognitive involvement and the formation of metacognition that occurs during the tertiary level of academic writing.

Aside from the linguistic and rhetorical advantages, digital technologies develop multimodal ways of composition and broaden the notion of writing competency to digital and visual literacies. For example, Canva and other purely interactive tools, which are created to facilitate multimodal argumentation, now enable digital students to combine text, visual and audio elements in the form of storytelling and visual communication (Rasyid et al. 2025; Anderson et al. 2020). These methods stimulate students' creativity and engagement by enabling them to make intentional decisions during the design and communication process. In turn, this process helps them establish a visual language and enhances their own capability to deliver knowledge in an appropriate and effective manner. This growth in writing skills matches the changing requirements of academic writing, especially in tertiary education, where students are increasingly expected to generate various types of academic texts (Anderson and Kachorsky 2019; Hoxhaj 2024). Overall, the various functions of digital tools not only develop multimodal competencies, but they can also dramatically improve general writing performance.

As reported in the literature, the positive results of using digital tools are constant motivation, continued engagement and long-term writing efforts. Students' motivation in writing platforms, interactive applications and immediate feedback systems increases when these tools are gamified, especially amongst less involved or less confident students who need to be attracted to more conventional learning environments (Shen et al. 2024). Timely and practical feedback promotes a feeling of success and builds on the effects of constant practice, which is the key to creating strong writing habits (Tran 2025; Ashrafganjoe 2025). Moreover, the ability of AI and digital resources to adjust feedback depending on specific learners' needs also entails the possibility of scaffolding based on the factors of language proficiency, background and writing experience. Such features of adaptation are also essential in tertiary contexts in which learners tend to differ greatly in writing skills and must thus be provided with differentiated instructional support to reach academic standards.

However, the maximised use of digital tools still requires pedagogical and instructor integration, even though its benefits are evident. For example, studies indicate that AI-based feedback can be misunderstood without teacher mediation, resulting in superficial revisions of the work or excessive dependence on the guidance provided by automated systems (Baz and Aksoy 2025). To be successful, the implementation of digital tools has to be integrated into the systematic knowledge bases of the framework, which shows learners how to decipher responses and implement changes critically and reflectively in their writing processes (Chen and Gong 2025; Al Mulhim and Ismaeel 2024). Institutional support, proper training and resource availability are important factors to ensure that both teachers and learners are equipped and prepared to make good use of these technologies to

improve writing ability. Research also indicates that at universities that emphasize the significance of digital literacy education and introduce writing courses integrated with AI use to support writing and editing student papers, the effects on students' writing outcomes, interactions and confidence are also objectively measured (Strobl et al. 2019; Huang et al. 2024).

II. Supporting Personalised and Adaptive Learning Journeys

Digital tools used in tertiary education have the potential to provide personalised and adaptive learning experiences, ensuring individualised experiences based on individual learners' needs, preferences and skill levels. Personalised learning in academic writing uses technologies such as AI-powered writing assistants, automated feedback processes and adaptive digital platforms to deliver students with specific guidance and scaffolds to learn the necessary skills in ways that were not always possible with traditional teaching (Nguyen 2025; Alharbi 2023). By accurately identifying the patterns and types of errors in the writing and engagement metrics of students, such systems can provide tailored interventions, such as adaptive prompts, example-based guidance and personalised feedback loops, which in turn allow students to advance at their own speed and fill certain knowledge or competence gaps (Tran 2025; Zhai and Ma 2023).

Prime examples of the integration of AI-assisted writing assistance (e.g. ChatGPT and ProWritingAid) programmes represent the ways in which personalised learning could be incorporated into tertiary settings. These types of tools can offer corrective feedback, propose alternative wordings, show students how to argue out certain ideas and demonstrate genre-specific writing structures; they can also be adjusted to users' proficiency levels and learning patterns (Song and Song 2023). As an illustration, students facing difficulties working with complex sentence constructions might be given special exercises and examples, whereas students with better proficiency levels can be offered more difficult tasks. This flexibility increases cognitive work and metacognition awareness because the students think about themselves, analyse their strengths and weaknesses and use feedback to improve their skills and excel in their studies (Chen and Gong 2025; Imran and Almusharraf 2023).

Digital learning also promotes individualised learning, as it enables learner control and self-directed learning behaviours. Furthermore, tools with built-in features such as progress tracking, formative assessment and interactive feedback provide students opportunities to track their writing growth through time and make effective choices regarding their learning focus (Agrati and Beri 2025; Pitukwong and Saraiwang 2024). For example, those platforms that have dashboards featuring common mistakes, choice of lexicon, or rhetorical quality enable learners to design objectives, revise priorities and repeat draft writing. These systems help fulfil students' learning objectives by allowing them to control their writing process; furthermore, as has been researched and demonstrated, this approach is

linked to increased engagement, motivation and long-term enhancement in academic life at the tertiary level (Huang et al. 2024; Ashrafganjoe 2025).

The adaptive learning of digital writing programmes can also be facilitated by the collaborative nature of their features, creating the possibility of peer-mediated scaffolding. Peer review systems, commenting systems and co-authorship systems also provide students with different perspectives on their own writing and help them adjust their methods based on other people's feedback (Aull 2020). The adaptability of these platforms also encourages various degrees of involvement, enabling learners to tailor their interactions based on their confidence level, previous experience and the appropriate learning objectives. Along with this, AI-created guidance and interactions with peers assist in filling the gap in terms of the lack of instructors, as students will receive constant support in an even larger tertiary classroom where they can hardly receive individual attention (Nguyen 2025; Chen and Gong 2025).

Despite these benefits, the implementation of adaptive learning through the personalisation of learning needs must be integrated carefully into curricula. In particular, scaffolding and orientation should be offered by the teachers to ensure that AI-generated feedback is interpreted correctly by students and that they do not overuse the automated suggestions (Baz and Aksoy 2025; Al Mulhim and Ismaeel 2024). Furthermore, as instructors are required to provide training and institutional support, the effectiveness of these technologies must be maximised. Pedagogical strategies, when introduced into digital tools, enhance students' ability to solve problems independently, think critically and reflect on themselves (Strobl et al. 2019; Khampusaen 2025). Through proper application, custom and real-time Web-based interventions can revolutionise the domain of teaching academic writing in HEIs, resulting in a rise in student motivation and the acquisition of necessary writing competencies.

III. Fostering Inclusive and Equitable Learning Environments for Diverse Learners

Online technologies are important in academic writing, as they help enhance inclusive and equitable learning experiences within HEIs. Unless properly dealt with, disparity in learners' academic performance can occur due to differences in their background and ability levels. Related to this, 'inclusive digital writing teaching' refers to the instructions that consider and address linguistic, cognitive and sociocultural diversity in students, ensuring equitable access to high-quality resources and useful feedback. Recent studies have shown that adaptive learning systems, automated feedback tools, AI-powered writing assistants and other interventions involving technology can effectively bridge the gap in competencies amongst students by offering guidance customised to their individual learning requirements (Nguyen 2025; Alharbi 2023). These technologies are used to solve persistent issues in student achievement, such as a lack of individualised attention in large classrooms and unequal access to previous educational experiences. These tools can also be especially beneficial to students facing problems while

learning English as a second language (ESL) and those with different writing abilities (Song and Song 2023; Baz and Aksoy 2025).

Incorporating the use of AI applications such as ChatGPT and ProWritingAid enhances inclusivity because it provides learners with consistent and fair feedback, which will allow them to engage in the writing process more constructively and effectively, regardless of their linguistic and academic backgrounds (Amer et al. 2025; Sutrisno et al. 2025; Chen and Gong 2025). Such systems may also be adjusted to accommodate nonnative speakers of English so that, instead of being stigmatised due to being publicly corrected in a traditional classroom setting, they can build grammar, vocabulary and rhetorical competencies without these challenges (Nguyen 2025; Khampusaen 2025). Furthermore, digital feedback is iterative and instant, allowing students to revise their work at their own pace, which is a great advantage because diverse learners need different timeframes or repetitions to grasp writing rules (Tran 2025; Zhai and Ma 2023).

Digital tools also ensure equal participation through the provision of multimodal, open and interactive learning. In particular, digital storytelling and apps based on visual writing help learners with different strengths and preferences convey their ideas in a user-friendly and impactful way, thus improving their ability to process higher-order ideas (Rasyid et al. 2025; Anderson and Kachorsky 2019). In one example, students with less confidence in their text writing may use images to make their arguments without violating academic standards, resulting in improved writing competency and decreased inequities in the scores (Pitukwong and Saraiwang 2024). These options are also more inclusive and accessible, contributing to a culture of learning in which many ways of knowledge construction are justified and supported in accordance with certain attitudes to modern pedagogic principles wherein equity and representation are valued, and learners have some control over their educational resources (Ashrafganjoe 2025).

Education that uses digital tools, starting from peer feedback and collaborative writing, also facilitates the creation of inclusive learning settings because it allows students to use different points of view and support systems (Aull 2020; Imran and Almusharraf 2023). Formal peer review in online environments permits a fair level of interaction, as students with varying levels of proficiency can interact without hierarchical constraints or intimidation (Adeyeye et al. 2022). The system of AI-based instruction and the engagement of peers are also beneficial for all learners, except those with minimal past experience of academic writing, as they are provided with significant, context-related assistance, ultimately contributing to forming confidence and competence (Nguyen 2025; Baz and Aksoy 2025).

Despite these benefits, fair application should be done by planning institutional-level support, instructor training and cautious approach towards digital resources; doing so mitigates current gaps, such as the presence of inequality regarding technology usage or reliance on automatic prompts without critical judgment (Strobl et al. 2019; Khampusaen 2025). As long as they are appropriately used, digital interventions have the potential to enhance writing competence via empowering and supportive learning experiences in which tertiary learners can

thrive, communicate and become agents in the academic writing processes (Chen and Gong 2025; Al Mulhim and Ismaeel 2024).

IV. Navigating Pedagogical Tensions and Ethical Considerations

The introduction of digital tools as teaching technologies in the academic writing (tertiary level) sector implies a series of pedagogical contradictions and ethical dilemmas that teachers must balance to provide learners with the full benefits and opportunities of the learning experience, without committing any ethical offences. Although AI-based writing tools and automated feedback systems, as well as digital collaborative tools, improve efficiency and engagement and provide personalised support, they also eliminate traditional concepts of author independence, academic integrity and teacher authority (Chen and Gong 2025; Khampusaen 2025). For example, a main tension is associated with preserving the originality of student work and the use of AI to scaffold student learning. The inherent accessibility of generative AI makes it easier to blur the role of effort and machine assistance in students' outputs and makes them entirely dependent on automated tools instead of allowing them to think critically, solve problems and write original papers (Song and Song 2023; Sutrisno et al. 2025).

Moreover, ethical issues have been identified concerning the problem of academic honesty and plagiarism. Organizations and Higher Education Institutions also struggle with the challenge of defining and controlling the use of AI-aided writing without compromising the academic rigour of writing. It has been argued that AI feedback may be viewed by students as a valid aid but not a shortcut; however, in the absence of guidelines on their appropriate use, dependence on such tools can potentially undermine ethical behaviours (Agrati and Beri 2025; Baz and Aksoy 2025). The professionals are thus burdened with the responsibility of imparting to students the myths of responsible AI use, the need to apply transparency in referencing machine-generated recommendations and the critical analysis of automated recommendations to help students develop competence and integrity in their academic writing (Tran 2025; Chen and Gong 2025).

There are also pedagogical tensions in matching the functionality of digital tools to specific learning objectives. Although AWE systems can reveal the linguistic correctness of a text instantaneously, they can be ignorant of argumentation, rhetorical nuances, or disciplinary conventions; thus, they require controlled mediation on the part of instructors (Zhai and Ma 2023; Alharbi 2023). In this regard, teachers are responsible for ensuring that the incorporation of AI feedback with human guidance must be used as a complementary tool to achieve reflective interactions with the feedback process. Furthermore, the equity of technological access is an essential issue. The unwanted drawbacks on students with lower levels of digital literacy, fluctuating internet access or disruptive devices can be unintended consequences; therefore, intellectual policies and support structures must be implemented to assist all learners in taking advantage of technological upgrades (Nguyen 2025; Strobl et al. 2019).

Finally, digital writing tools require continuous professional training of the teaching staff. Instructors should also develop the ability to not only use the tools but also create ethical and pedagogically suitable digital feedback, peer work and learning adaptation structures (Imran and Almusharraf 2023; Jongsma et al. 2023; Sutrisno et al. 2025). With the integration of technology skills and pedagogical awareness, tertiary educators can reduce potential ethical issues, meet the needs of diverse learners and maintain the quality and richness of academic writing teaching.

In summary, the carefully executed adoption of digital tools based on ethics and pedagogy can eventually improve learning performance amongst students and help achieve the overall educational mission of HEIs (Chen and Gong 2025; Strobl et al. 2019).

Discussion

The results of this systematic review suggest the revolutionary possibilities of using digital tools in teaching writing in tertiary education, as well as demonstrate subtle issues that have to be resolved to make pedagogical integration successful. Educational technologies, such as those assisted by AI, automated writing analysis devices, collaborative writing technology and multimodal composition software, have been shown to have a consistent positive effect on developing writing skills. They facilitate writing in a more interactive and proactive way and scaffold writing and rhetorical practices by enabling authors to write in an iterative way and give immediate feedback, as well as scaffold linguistic and rhetorical abilities (Strobl et al. 2019; Zhai and Ma 2023; Song and Song 2023). These are consistent with earlier studies, which hypothesised that technology-based feedback not only enhances superficial accuracy but also contributes to more advanced writing in terms of argument, organisation and genre awareness (Chen and Gong 2025; Tran 2025).

Furthermore, online resources can help provide learners with customised and adaptive learning experiences, as they allow students to work with feedback on their own schedules and at their own pace. Devices that embed AI algorithms or learner-controlled scaffoldings also enable students to learn to target particular areas of weakness, whereas collaborative platforms promote peer interaction and knowledge co-construction, enabling students to experience effective metacognitive and self-controlled learning (Imran and Almusharraf 2023; Nguyen 2025). This sort of inclusivity in HEIs makes it possible to teach writing to a wider range of learners and acts as a means of inclusion for nonnative speakers of English, as well as students with lower levels of digital literacy, helping them receive several levels of teaching support (Nguyen 2025).

Nevertheless, there are also pedagogical and ethical conflicts in relation to the introduction of digital tools into academic writing. The academic integrity and excessive reliance on technology, as well as the possibility of losing the capability of critical thinking in case the authors use automated recommendations,

are linked with reliance on AI-aided feedback (Agrati and Beri 2025). Moreover, differences in access to digital resources and technological proficiency amongst students can widen inequalities in the achievement of writing; therefore, close consideration should be given to providing scaffolding, training and institutional support to guarantee equal access (Strobl et al. 2019; Sutrisno et al. 2025). Therefore, teachers must be able to balance their abilities in technology with the instructional control to develop the reflective, capable and moral aspects of using technology in preserving the strict criteria of academic writing.

In summarising the existing evidence, it can be concluded that digital tools have significant potential to boost academic writing improvement in tertiary education, although their effectiveness depends on conscious, evidence-based application. With a thorough combination of guided practice, professionalisation of the process and future-oriented accessibility, these technologies have the potential to make writing instruction more versatile and interactive, thus accommodating the needs of students and preparing them to meet the requirements of 21st-century academic and professional communication (Tran 2025; Rasyid et al. 2025; Chen and Gong 2025). Future studies must also explore long-term implications, how to integrate the best multiple modal and AI-driven tools and various ways of tackling the possible ethical and equity dilemmas.

Towards Pedagogical Integration and Best Practices

In all three RQs posted earlier, the results lead to one main conclusion: the pedagogical approach to integration is far more important than the particular digital tool being used. Thus, the best strategies are to include digital technologies in responding to identified learning goals, scaffold their application and develop the student capacity to interact with automated feedback critically (Nabhan 2021). Digital platforms used as part of the designed pedagogical systems contribute to the mastery of linguistics and advanced rhetorical skills. On the one hand, a balance between immediacy and depth may be achieved through automated writing assessment, which, together with sequential drafting and guided teacher meetings, empowers students not only to correct the language to score the piece but also to acquire the complexity of the writing rules (John and Woll 2020). It has also been shown that hybrid feedback systems that incorporate the best practices of both worlds are capable of providing faster AI-generated feedback and more nuanced human feedback, which could lead to significant improvements in the quality of the revision itself and students' overall writing proficiency within the context of HEIs (Zhai and Ma 2023).

Moreover, encouraging the metacognition of online feedback enhances students' attitudes towards the process of writing. The integration of such tools as grammar checkers, AI-written assistants, or co-writing features into various phases of the writing process (prewriting, drafting, revising and peer review) helps maximise the benefits of learning and promotes self-regulation (Pitukwong and Saraiwang 2024). Another crucial element is teacher readiness. The achievement

of sustainable pedagogical integration involves specific professional growth leading to the development of digital literacy, evaluative judgment and the skills of educators to operate amidst a world of rapidly changing technologies (Alharbi 2023; Nazari et al. 2021). Any efforts to design tools that are well-constructed without this base are likely to allow a rather surface-level implementation of these tools, which may perpetuate either formulaic writing or the overuse of automated tools rather than developing critical academic skills.

Limitations and Future Directions

One limitation of this review is that it used only published studies, which could introduce selection bias and the exclusion of under-researched settings, especially in low-resource tertiary institutions. Little evidence exists on how generative AI tools might influence the long-term outcomes (metacognitive development and disciplinary literacy) and critical thinking of students. Hence, future works could focus on the improvement of digital feedback and undertake longitudinal studies to trace the effects of digital feedback on academic writing growth in the long term, with a specific emphasis on linguistically diverse and nontraditional students (Nabhan 2021).

A comparative analysis of the integration of digital tools in disciplines and at various levels of education might be an excellent way of understanding how such tools can be most effectively adapted to any situation. The issue of solving algorithmic bias and providing fair access to technology is also urgent. Research emphasises that students perceive the most positive impact when the feedback is mediated by instructors to place the automated suggestions within assistive learning conditions in their appropriate contexts (John and Woll 2020; Zhai and Ma 2023). Furthermore, the interaction between teacher mediation and learner agency and the capabilities of tools to determine the optimal practices to ethically integrate such tools into pedagogy should be investigated in the future. Professional growth will be one of the pillars, and providing educators with principles on selecting tools critically, using them ethically and adapting pedagogy to new digital environments will become an important tool in the discussion.

Conclusion

This study underscores the transformative yet complex role of digital feedback tools and writing assistants in teaching academic writing across the educational continuum. Synthesising research on tools ranging from AI-driven natural language processing applications to digital storytelling platforms and sophisticated AI-powered writing assistants, this review illuminates the diverse mechanisms through which technologies can enhance writing proficiency, facilitate personalised learning pathways and cater to varied learner needs. The collective findings strongly suggest that digital feedback, particularly mechanisms offering imme-

diate and individualised responses, significantly fosters student engagement, improves specific aspects of writing quality and scaffolds the often-challenging revision process.

The use and emphasis of the abovementioned tools vary based on levels of education. Developing a background in writing is the key aspect, and the digital tools examined in this paper are effective in incorporating the norms of grammar, punctuation and vocabulary, usually via more engaging techniques such as digital storytelling or gamified practice. These tools also support skill development and student motivation (Rasyid et al. 2025). More importantly, teacher mediation and peer feedback are essential counterparts. In particular, pedagogical requirements shift towards more advanced rhetorical skills as learners progress through tertiary education. In this instance, although digital tools (e.g. AWE systems and AI assistants) may be a possible support in the process of complexity management, exploration of argumentation and participation in self-editing, the need to guide students into critically decoding the feedback given to them and focus on higher-order thinking is further clarified (Zhai and Ma 2023).

Despite the abovementioned advantages in the area of higher education, although digital aids offer beneficial analytic information and feedback as to structure and style, current research shows that subtle, context-specific feedback delivered by experienced teachers cannot be substituted by any means, especially when it comes to developing profound levels of critical thinking, discipline and self-control amongst students. This human factor plays a crucial role in customising feedback strategies to the requirements of individual learners and overcoming learning challenges, such as dyslexia, other linguistic statuses and the need to have different approaches to learning. Empirical research offering results on this issue is limited, but existing studies indicate that when automated feedback is used alone, students do not think that it is helpful in developing complex writing and thinking, in comparison to dialogic, individual feedback. Therefore, this requirement becomes a decisive element under the conditions of inclusiveness and maximum pedagogical effectiveness of any feedback process, whether of the digital or the human type. Consequently, preparing educators and ensuring the comprehensive development of professionalism are inevitable conditions for the successful introduction of these technologies (Tran et al. 2023).

In conclusion, this systematic review demonstrates that the effectiveness of digital feedback systems and writing support tools in teaching writing does not depend solely on technology. Instead, it depends on cautious pedagogical integration, careful response to the development levels of students and their respective needs, as well as the application of a proactive strategy towards ethics and equity considerations, including the digital divide (Rasyid et al. 2025). In the short term, academic writing instructors can capitalise on technology to support the development of writing skills at the tertiary academic level. In the long term, thoughtful coordination between feedback practices and digital tools within learning environments can further contribute to improving students' learning profiles.

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RAZISKOVANJE POTENCIALA IN POSLEDIC UPORABE DIGITALNIH ORODIJ PRI POUČEVANJU AKADEMSKEGA PISANJA

Povzetek: Predstavljena študija temelji na sistematičnem pregledu strokovne literature in proučuje pedagoški potencial in vpliv digitalnih orodij na poučevanje akademskega pisanja. Pregled združuje empirične in teoretične študije ter analizira, kako digitalni mehanizmi za podajanje povratnih informacij – npr. sistemi za avtomatizirano ocenjevanje pisanja, pripomočki, ki uporabljajo umetno inteligenco, in multimodalne platforme – vplivajo na pisno zmožnost, podpirajo personalizirano učenje in spodbujajo vključujoče prakse. Ugotovitve kažejo, da digitalna orodja izboljšujejo natančnost na površinski ravni, vključenost in navade pri popravljanju, vendar je njihova učinkovitost v veliki meri odvisna od njihove integracije v pouk, prilagoditve potrebam učencev in uporabe za reševanje etičnih izzivov in izzivov na področju pravičnosti. Prispevek obravnava tudi druga kritična vprašanja, med drugim znanstveno integriteto, algoritmično pristranskost in tveganje, ki ga prinaša prekomerno zanašanje na avtomatizacijo. Na koncu pa članek poudari še pomen premišljene integracije, digitalne pismenosti in učiteljevega usmerjanja v to, kako naj digitalna orodja podpirajo razvoj akademskega pisanja.

Ključne besede: digitalna orodja, poučevanje akademskega pisanja, izobraževalna tehnologija, sistematični pregled

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