

Systematic Review: How Technology Supports Collaborative Writing Learning in Higher Education

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<https://doi.org/10.34190/ejel.23.3.3974>

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Abstract: Technology-enhanced collaborative academic writing (TECAW) in higher education has gained increasing attention due to its potential to enhance students' academic writing skills through interaction, shared authorship, and structured pedagogical support. Framing collaborative academic writing (CAW) as a pedagogical process, this systematic literature review explores how digital technologies and instructional strategies have been utilised to support students' engagement across the writing phases. A total of 27 peer-reviewed empirical studies, published between 2014 and 2024 and indexed in the Scopus database, were analysed using the PRISMA 2020 framework to ensure methodological rigour and transparency. The findings identified twenty types of technologies applied across the three phases of CAW including prewriting, in-writing, and post-writing. These technologies were categorised into five groups: collaborative study tools, classroom-based technologies, cloud-based word processors and shared documents, network-based social computing, and supporting tools. Frequently utilised platforms, including Google Docs, Moodle, Zoom, and WhatsApp, functioned either as interactive collaborative spaces that foster communication and idea co-construction or as task-supporting tools that facilitate drafting, feedback, and revision activities. In parallel, six core instructional strategies were identified: prewriting activities, scaffolding, peer review and feedback, collaborative revising and editing, reflective tasks, and collaborative note-taking. These strategies were systematically mapped across the writing phases, supporting not only the technical aspects of writing but also promoting collaborative interaction, critical thinking, and reflective learning practices. Importantly, the review highlights that successful TECAW implementation requires the intentional orchestration of technologies and instructional designs to align with the pedagogical goals at each stage of collaborative writing. The review emphasises that the effective integration of technology in CAW must be intentionally aligned with the pedagogical objectives at each stage of writing, ensuring that tools not only enhance task performance but also strengthen students' collaborative engagement and academic writing development. Overall, this study offers valuable insights for educators and researchers seeking to design student-centred, technology-supported writing instruction that reflects evolving digital pedagogies in higher education.

Keywords: Scientific writing, Collaborative writing, Technology-enhanced collaborative academic writing learning

1. Introduction

In recent years, academic writing has emerged as a critical competency for university students, who are expected to engage with disciplinary knowledge, present evidence-based arguments, and communicate ideas with clarity and coherence (López-Pellisa, Rotger and Rodríguez-Gallego, 2021; Li *et al.*, 2024). However, mastering academic writing is a cognitively demanding process that involves continuous practice, feedback, and reflection (Li *et al.*, 2024). Recognizing the limitations of traditional, individual-centred writing instruction, many educators have turned to Collaborative Academic Writing (CAW) as an alternative pedagogical approach. In this study, CAW is conceptualised not simply as co-authorship, but as a structured and intentional learning process that facilitates the development of academic writing skills through social interaction, peer feedback, and mutual responsibility (Storch, 2013; Li, 2018).

CAW engages students in all stages of the writing process (planning, drafting, revising, and reflecting) while fostering negotiation of meaning, shared decision-making, and reciprocal learning (Hsu, 2019; Lingard, 2021). This process encourages students to actively construct knowledge, sharpen their arguments, and gain a deeper understanding of academic conventions. Positioning CAW as a learning process emphasises its potential to support students' development of writing skills through iterative collaboration, consistent with constructivist theories of learning (Vygotsky and Cole, 1978). The inherently social nature of CAW helps students become more conscious of audience, clarity, and structure, while also cultivating communication, teamwork, and

metacognitive awareness. By engaging in collaborative writing tasks, students are encouraged to reflect on their contributions, critically evaluate peer input, and revise their work accordingly (Storch, 2013, 2017).

At the same time, the integration of technology-enhanced learning (TEL) has revolutionised how CAW is facilitated in higher education. In this study, TEL refers to the use of digital platforms, tools, and applications to support, mediate, and enhance the learning process involved in collaborative writing. Technology can enhance this collaborative process by providing tools and platforms that facilitate communication, coordination, and access to information. The use of technology such as Google Docs allows students to collaborate in real-time, share documents, comment, and edit writing together without having to meet face-to-face (Jeong, 2016; Costley and Fanguy, 2021; H. Zhang *et al.*, 2022; Kaur and Chowdhury, 2022; Kitjaroonchai and Phutiketrakit, 2022; Alhazmi and Elamin, 2023; Burris-Melville and Burris, 2023; Fanguy, Costley, *et al.*, 2023). Online discussion forums and learning management applications such as Google Classroom, Moodle, and Microsoft Teams allow students to discuss, plan assignments, and organise work more effectively (Miftah and Cahyono, 2022; Burris-Melville and Burris, 2023; Sundari and Febriyanti, 2023; Hati and Bhattacharyya, 2024; Jusslin and Hilli, 2024). In addition, technology also overcomes geographical boundaries, allowing students from different locations to work together and share knowledge (Kaur and Chowdhury, 2022). Technology also indirectly supports the development of critical thinking skills in academic writing by mediating the activities of reflection, analysis, and continuous evaluation of academic writing (H. Zhang *et al.*, 2022; Malik *et al.*, 2023).

Despite the proliferation of digital tools in higher education, it remains unclear how technology and instructional strategies are integrated into CAW as a learning process. Existing studies often highlight either the benefits of collaboration or the usefulness of individual tools, but offer limited insight into how digital technologies actively support students' progression through the phases of academic writing, from prewriting to post-task reflection (Storch, 2019; Zhang and Zou, 2022). Moreover, the alignment between technological affordances and pedagogical goals have a significant impact on the quality of students' academic writing (Cahyono *et al.*, 2023; Herdianto *et al.*, 2024). But it is not always made explicit, leaving a practical gap in guiding educators to effectively design technology-supported collaborative writing instruction.

To respond to the increasing interest in integrating technology into writing pedagogy, this article aims to provide a structured synthesis of empirical studies that examine how technology supports collaborative academic writing (CAW) as a pedagogical process in higher education. In doing so, it contributes to a deeper understanding of how specific technologies and instructional strategies are applied across different phases of CAW, and how these tools mediate learning outcomes. By synthesising recent findings, this review aims to provide educators, instructional designers, and researchers with evidence-based insights for developing effective, student-centered, and technology-integrated writing practices in higher education.

In particular, the objective of this review is to systematically analyse and categorise the types of technologies used and instructional strategies implemented to support CAW in tertiary education settings. To achieve this objective, the following research questions were formulated:

RQ1. What types of digital technologies have been implemented to support collaborative academic writing as a pedagogical approach in higher education?

RQ2. What instructional strategies have been employed to facilitate technology-enhanced collaborative academic writing across different stages of the learning process?

2. Literature Review

2.1 Collaborative Academic Writing as Pedagogical Learning Approach

Academic writing in higher education demands a complex combination of cognitive, linguistic, and disciplinary knowledge. Students are required to construct evidence-based arguments, structure coherent texts, and engage with scholarly literature using discipline-specific conventions (Hyland, 2013). Academic writing involves critical thinking, problem solving, and justification, as students must evaluate sources, synthesise ideas, and organise arguments to meet academic expectations (Suyitno, 2012; Marni *et al.*, 2019; Chuang and Yan, 2023). In this context, collaborative academic writing (CAW) plays a crucial role. It enables students to co-construct knowledge, engage in scholarly discourse, and build essential skills such as reasoning, audience awareness, and communication. Studies show that CAW enhances students' ability to comprehend academic content, articulate ideas clearly, and produce more sophisticated written work (MacArthur and Graham, 2016; Li *et al.*, 2024). These collaborative practices are particularly relevant as higher education increasingly emphasises interdisciplinary work, teamwork, and real-world writing scenarios.

Within this context, Collaborative Academic Writing (CAW) emerges not only as a learning outcome but also a pedagogical approach that fosters academic writing learning through co-construction, interaction, and reflection. Rooted in constructivist learning theory, particularly Vygotsky's concept of the Zone of Proximal Development (ZPD) (1978), CAW provides an environment where learners develop their writing skills through meaningful social interaction and negotiation of meaning. Learning occurs within the ZPD, as peers scaffold each other's understanding of content and writing conventions. Meaningful learning can occur at the ZPD, which is described as the gap between the current level of development of learners' capacities and their developmental potential.

CAW involves distinct stages—brainstorming, conceptualising, outlining, drafting, reviewing, revising, and editing—each requiring collaboration, shared responsibility, and continuous communication (Ede and Lunsford, 1992; Li, 2018). These stages support not only writing competence but also higher-order skills such as critical thinking, teamwork, and metacognitive reflection (Storch, 2017; Ramadhanti *et al.*, 2019). As such, CAW aligns closely with pedagogical goals of active, student-centered learning that develops both academic literacy and 21st-century competencies.

2.2 Technology-Enhanced Collaborative Writing

With the evolution of digital learning environments, a growing number of digital tools have been incorporated into collaborative writing practices in educational settings since 2009 (Storch, 2019; Chen and Hapgood, 2021). Li (2018), through a systematic review of 21 studies published between 2008 and 2017, highlighted computer technologies, wikis, and Google Docs as the most commonly utilised tools in Technology-Enhanced Collaborative Writing (TECW). Similarly, Storch (2019), after analysing significant studies on collaborative writing from 1997 to 2017, noted that most TECW implementations were grounded in the use of computer-based and online technologies. Zhang and Zou (2021) identified six widely used tools in TECW activities: wikis, Google Docs, chat platforms, Facebook, online forums, and offline word processors.

The integration of new technologies has had a generally positive influence on learners' engagement and perceived benefits in collaborative writing (Li, 2018; Zhang and Zou, 2022). These tools promote peer interaction, facilitate self-assessment and error recognition, enhance motivation and confidence, simplify the writing and editing process, and contribute to a more engaging and enjoyable learning environment (Zhang and Zou, 2022). However, the success of TECW is not guaranteed, especially when learners struggle with unfamiliar technology or group collaboration (Zhang and Zou, 2022). Additional factors, such as task type, tool selection, language proficiency, and group dynamics, can also significantly impact TECW outcomes (Storch, 2011).

2.3 Limitation of Previous Review Studies

Although the application of technology in collaborative academic writing has been investigated, systematic reviews in this domain remain limited. Several existing reviews highlight important trends but are either focused on different educational levels or broader writing skills, not specifically academic writing at the higher education level.

For instance, Williams and Beam (2019) systematically reviewed studies on technologies used to mediate writing instruction and writing tasks. The use of technology motivates student engagement and participation in writing tasks and enhances social interaction and peer collaboration. However, the study concentrated on writing development at the early childhood, elementary, middle, junior high, and high school levels. Furthermore, Akhtar *et al.*, (2019) provided a systematic literature review on academic writing studies that focused on investigating students' academic writing challenges and solutions. This literature review concluded the need for strategies that help improve students' writing skills. However, the articles reviewed were also limited to ESL students in Malaysia as the research context. While Zhang and Zou (2022) reviewed 34 empirical research articles and identified various technologies that can enhance the collaborative writing process. The integration of technology in writing instruction encourages group interaction, helps students reflect on their work and identify errors and weaknesses, increases learner motivation and confidence, facilitates writing, encourages students to learn from others, and makes the learning process fun. However, the systematic literature review also only focused on ESL students.

Thus, to date, no systematic literature review has comprehensively explored technology-supported collaborative academic writing at the tertiary level, despite the distinctive complexity and expectations associated with academic discourse in higher education (Hyland, 2013). This review aims to fill that gap by synthesizing how digital technologies and instructional strategies are utilized to support CAW learning in university settings.

3. Methodology

The objective of this review is to identify and analyse the technologies and instructional strategies that support the process of collaborative academic writing in higher education. This study is a Systematic Literature Review that carries out a credible review process based on the PRISMA framework (Page *et al.*, 2021) (see Figure 1) to ensure transparency and rigour in identifying, selecting, and analysing relevant literature. The review focused on studies exploring the use of digital technologies and instructional strategies in collaborative academic writing (CAW) as a pedagogical process in higher education.

3.1 Review Protocol

The review process followed a structured protocol consisting of four phases: identification, screening, eligibility, and inclusion. The process and results are illustrated in the updated PRISMA 2020 flow diagram, and all reporting criteria have been aligned with the PRISMA framework, including details on inclusion criteria, search strategy, study selection, data extraction, and synthesis.

3.2 Data Source and Search Strategy

The literature search was conducted using the Scopus database, chosen for its extensive coverage of peer-reviewed and high-quality academic publications across disciplines. In response to reviewer feedback, especially those reporting empirical findings in the fields of education, instructional technology, and digital learning. The keywords used were (a) “collaborative” or “collaborative writing” or “write collaboratively” or “collaboratively write” or “collaboratively written” or “collaborative written text” or “learn collaboratively through writing” or “collaborative learning” and (b) “academic writing” or “academic text” or “scientific writing”; using AND connectors.

3.3 Inclusion and Exclusion Criteria

The articles were then selected based on the inclusion criteria. Studies were included if they:

- Were published between 2014 and 2024,
- Were written in English,
- Document type is an article
- Available in full text
- Relate to the research objectives, by focusing on technology-enhanced collaborative language learning (TECLL) within academic writing contexts.
- Reported empirical findings related to technology-supported collaborative academic writing in higher education,

Studies were excluded if they:

- Weren't written in English
- The type of document is book chapter, conference paper, review, and book
- No full text available
- Not focus on TECLL in academic writing context
- Not reported empirical findings related to technology-supported collaborative academic writing in higher education

From the search results, 316 articles were published between 2014-2024. Only articles that used English were selected, leaving 296 articles. The type of article document that will be analysed is only the type of research article. Document types such as book chapters, conference papers, reviews, and books were not included in the analysis so 206 articles were obtained. Of the remaining articles, only 95 articles were selected because of open access and continued in the title and abstract screening process. From the screening of titles and abstracts, 52 articles were obtained that were relevant to the research objectives. Furthermore, 25 articles were excluded because they did not have empirical data and were not in the context of collaborative academic writing learning in higher education. Thus, the screening ended with 27 articles to analyse.

3.4 Data Selection and Data Analysis

After applying the inclusion criteria and removing duplicates, titles and abstracts were screened. Full texts of the remaining articles were assessed for eligibility. To ensure inter-rater reliability, the coding process involved multiple stages. First, five articles were jointly selected by all reviewers to serve as a calibration set, representing a range of publication years, methodologies, and technology types. These articles were discussed collectively to

develop a shared understanding of the coding categories and thematic structure. In this stage, representative samples are chosen to align researchers on a consistent interpretation of the coding framework. A satisfactory agreement was reached at the end of the coding (Pearson's $r = 0.85$).

After this calibration phase, the remaining studies were independently coded by two researchers. Discrepancies were documented and discussed in regular review meetings, and consensus was reached through negotiated agreement. When needed, a third researcher served as an adjudicator. This iterative process enhanced the reliability and transparency of the data analysis. The final set of studies was analysed using thematic coding to identify recurring patterns in the use of technologies and instructional strategies across different phases of the collaborative academic writing process.

The synthesis focused on the pedagogical roles of technology in CAW, categorised by its function as an interactive collaborative space or as a task-supporting tool, and mapped to stages of the writing process. This analytic lens allows the review to offer insights into how technology and pedagogy intersect to support collaborative academic writing in higher education. To address the research questions, the 27 articles were analysed from two perspectives.

a. Technology in implementing technology-enhanced collaborative academic writing learning

This category concerns the types and use of technologies, platforms, digital tools, or online systems that teachers/researchers have used to support their implementation of collaborative academic writing learning activities. Technology included collaborative study tools, classroom-based technology, cloud-based word processors and shared documents, network-based social computing, and supporting tools. The categorisation of technologies and software for collaborative writing was adapted from Zhang et al., (2022) and Loncar et al., (2021).

b. Strategy used in implementing technology-enhanced collaborative academic writing learning

Collaborative writing can be systematically organised into three pedagogical phases: pre-collaborative writing, in-collaborative writing, and post-collaborative writing, each encompassing specific instructional practices designed to support the development of both writing and collaboration skills (R. Zhang *et al.*, 2022). The pre-collaborative writing phase focuses on building readiness by ensuring that students are cognitively and socially prepared to engage in the collaborative writing process. The in-collaborative writing phase involves the actual implementation of writing tasks, emphasising active communication, negotiation of meaning, and the establishment of shared responsibility among group members. Finally, the post-collaborative writing phase centers on evaluation and reflection, aiming to assess the collaborative process, the quality of the written product, and areas for future improvement. In this study, instructional strategies were identified and categorised based on these three phases of collaborative academic writing as outlined by previous research.

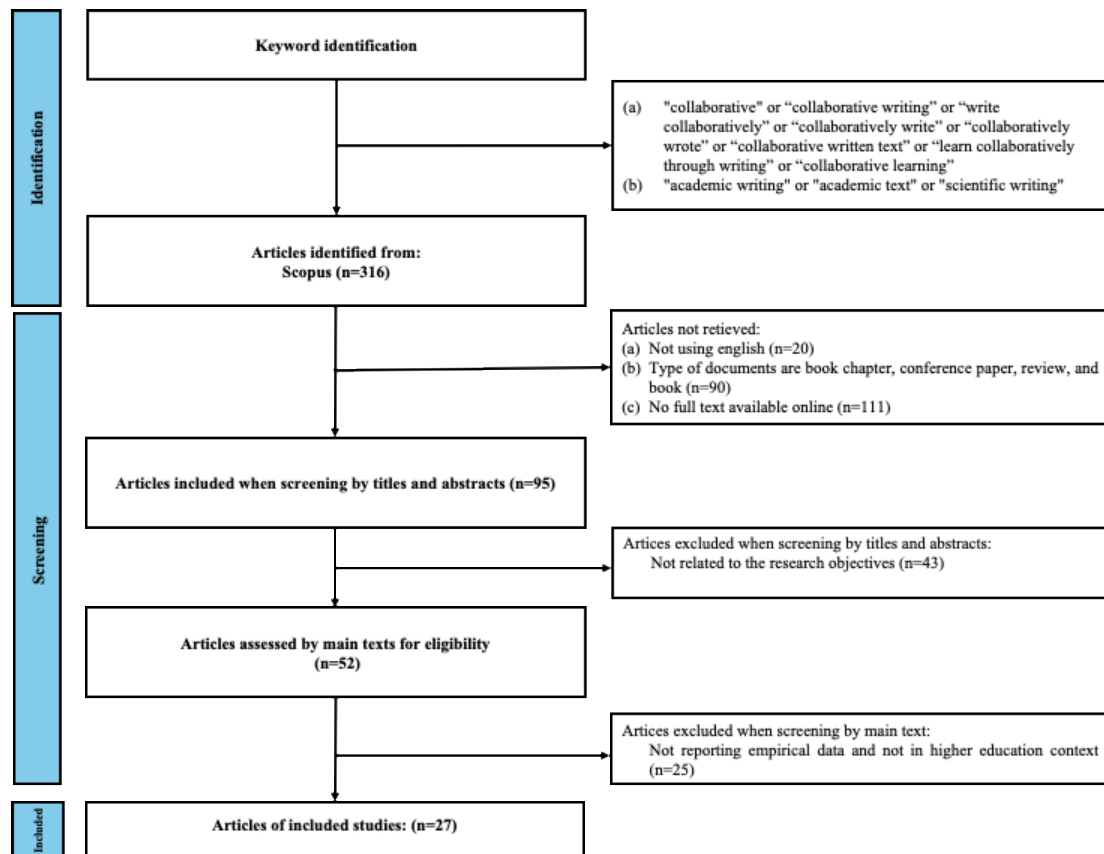


Figure 1: Process and method data search, selection, and collection

4. Findings and Discussion

4.1 Technologies that Supports Collaborative Academic Writing Learning

Based on the analysis of the selected research articles, 20 types of technology applied in collaborative academic writing learning can be identified (see Appendix A). Figure 2 shows the various technologies used in collaborative academic writing learning and Figure 3 shows the number of studies implemented technologies in CAWL per year.

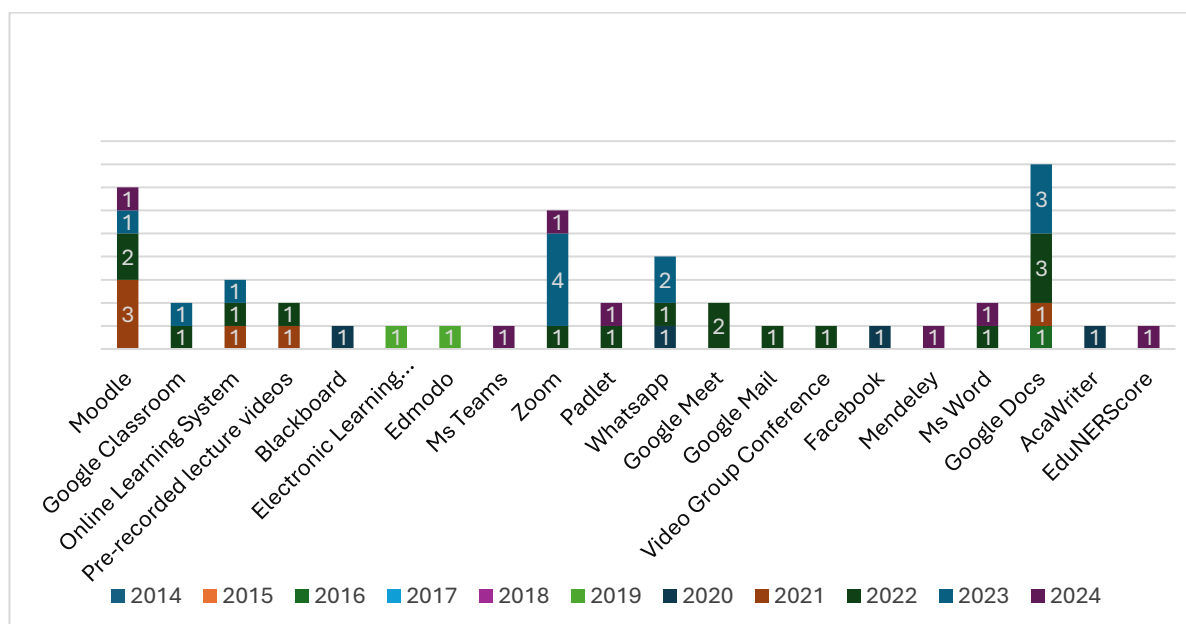


Figure 2: Numbers of Technology for Collaborative Academic Writing Learning Implemented in Studies

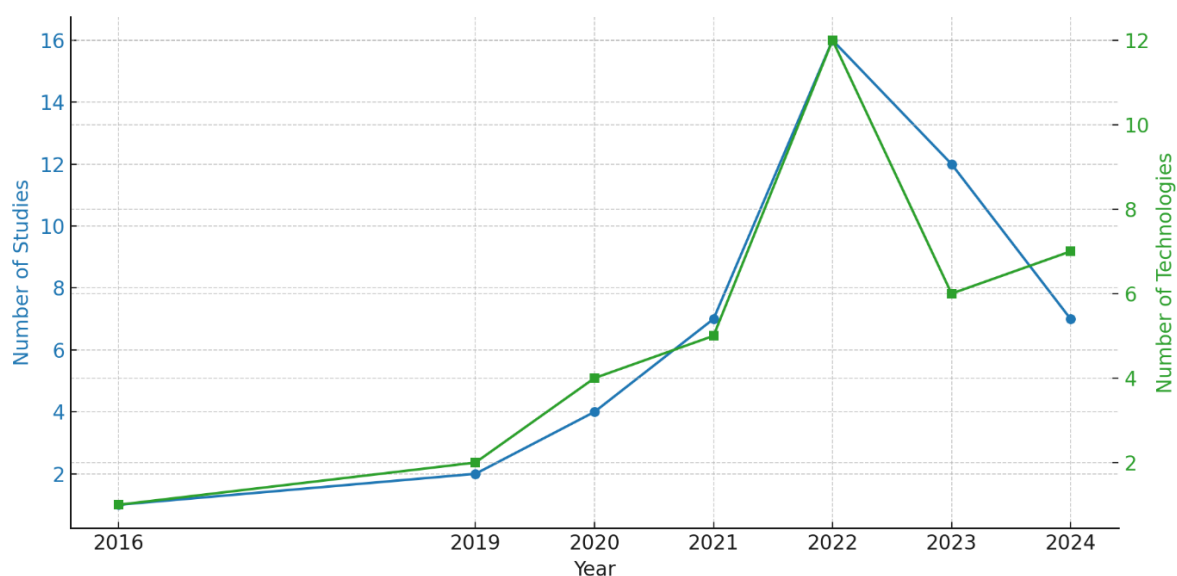


Figure 3: Technology Used in Collaborative Academic Writing Learning per Year

The analysis of technology use across publication years reveals a significant temporal trend in the integration of digital tools for collaborative academic writing (CAW). The year 2022 marks a peak in both frequency (16 studies) and diversity (12 technologies) of technologies adopted in CAW studies. This notable surge aligns with the global shift towards online and hybrid learning environments prompted by the COVID-19 pandemic, which compelled institutions to rapidly adopt digital platforms such as Google Docs, Zoom, and Moodle to sustain academic writing collaboration. The pandemic acted as a catalyst, not only accelerating technology adoption out of necessity but also expanding educators' and researchers' familiarity with a broader range of digital tools.

From 2019 onwards, a steady increase in the application of technology is observable, indicating growing scholarly engagement with technology-enhanced CAW. In contrast, the earlier part of the review window (2014–2018) reflects relatively limited activity, suggesting a lack of focus on technologically mediated CAW during that period. Although a slight decline is noted in 2023 in both the frequency and diversity of technologies, the continued presence of six or more distinct platforms suggests a sustained momentum. The trend continues into 2024, with seven technologies mentioned and increased reference to recently developed platforms, highlighting an ongoing post-pandemic shift towards digital adaptation and innovation in CAW practices.

Overall, this upward trajectory reflects not only the circumstantial influence of the pandemic but also a broader pedagogical transformation. The integration of digital tools into CAW appears to have evolved from a reactive response to a proactive, intentional strategy that underscores the pedagogical value of technology in supporting collaborative writing in higher education.

Based on the identification results, the technology applied in collaborative academic learning can be categorised based on its use which is shown in Table 1 as follow:

Table 1: The Type of Technology

Type of Technology	Technologies
Collaborative Study Tools	Padlet, Gmail, Zoom, Google Meet, Microsoft Teams, and Video Group Conference
Classroom-based Technology	Moodle, Google Classroom, Blackboard, Online Learning Systems, Electronic Learning Environment, Edmodo, Pre-recorded lecture videos
Cloud-based Word Processors and Shared Documents	Google Docs, Microsoft Teams
Networks-based Social Computing	Facebook, Whatsapp
Supporting Tools	Microsoft Word, AcaWriter, and EduNERScore, Mendeley

A single technology may fall into multiple categories depending on its functional use in the collaborative writing process. For example, Microsoft Teams can serve as a video conferencing platform as well as a collaborative

document editing tool. Accordingly, it was categorised simultaneously as both a Collaborative Study Tool and a Cloud-Based Word Processor to reflect its multifunctional role.

The purpose of using these various technologies is described as follows.

a. Collaborative Study Tools

Collaborative study tools were applied in eleven studies, consist of Padlet, Whatsapp, Facebook, Gmail, Zoom, Google Meet, Microsoft Teams, and Video Group Conference. One of the functions of using these technologies is to facilitate group discussions. Collaborative learning cannot be separated from group discussion activities. These technologies support both asynchronous and synchronous discussion processes.

Research has also found technology to be very helpful for collaborative discussion processes. Chatting in Zoom has excellent potential for synchronous written dialogue (Jusslin and Hilli, 2024). In addition, synchronous discussion written in Padlet showed a positive relationship with student collaboration (Jusslin & Hilli, 2024). As described by Kaur and Chowdhury (2022), students were satisfied with the discussion process through the WhatsApp platform because the work became easier and could be done at any time.

b. Classroom-based Technology

Fifteen studies applied classroom-based technology in the collaborative academic writing learning. Research conducted by Jusslin and Hilli (2024) showed that Moodle can serve as an asynchronous hybrid learning space that students can access as needed and also used synchronously through screen sharing for materials on the platform. Mulyati and Hadianito (2023) also found that using the Integrated Online Learning System as virtual learning environment could facilitate students in receiving and providing detailed feedback, which improved the quality of argumentative essays, feedback, and domain-specific knowledge.

In collaborative academic writing learning, teachers can manage learning synchronously or asynchronously using LMS (Jusslin and Hilli, 2024). Teachers can manage the learning flow through the LMS, and students can asynchronously manage the materials they want to access (Duin and Tham, 2020; Jusslin and Hilli, 2024). Several features like discussion forums, project groups, and cloud-based collaborative writing tools in the LMS promote students' socio-cognitive development and encourage process-based writing. These features create a social learning space that allows students to find topics of investigation together, define the problems together, and seek solutions (Duin and Tham, 2020). However, Jusslin and Hilli (2024) added that various collaborative and individualised spaces are needed to support students' academic writing.

c. Cloud-based Word Processors and Shared Documents

Nine studies were utilised Cloud-based Word Processors and Shared Documents in collaborative academic writing, including Google Docs and Microsoft Teams. Google Docs is one of the platforms that help the collaborative writing process. *Google Docs* is a web-based word-processing tool that allows multiple writers to collaborate and edit their writing synchronously in real-time or asynchronously. Technologies such as Google Docs and Microsoft Teams allow students to work together in real-time, share documents, provide comments, and track changes made by group members (Jeong, 2016; Costley and Fanguy, 2021; H. Zhang *et al.*, 2022; Kaur and Chowdhury, 2022; Kitjaroonchai and Phutiketrakit, 2022; Alhazmi and Elamin, 2023; Burris-Melville and Burris, 2023; Fanguy, Costley, *et al.*, 2023; Hati and Bhattacharyya, 2024). These tools not only facilitate better communication but also improve the coordination and effectiveness of teamwork (Burris-Melville and Burris, 2023). These tools allow collaborators to create texts at their preferred time and independent of space while using built-in chat or comment windows to interact with other team members and revisit their revision history to edit or revise the text they shared. Collaborating on web-based tools such as Google Docs can provide opportunities for learners to negotiate tasks, share linguistic resources, conceptualised lexical units and grammar rules, and further enhance cognitive advantages that affect knowledge acquisition at an individual level (Alghasab, Hardman and Handley, 2019; Chen, 2019). The use of web-based collaborative tools motivates learner engagement and participation in group writing, enhances peer interaction, and helps students to correct each other's mistakes (H. Zhang *et al.*, 2022; Kitjaroonchai and Phutiketrakit, 2022).

d. Networks-based Social Computing

Four studies employed Facebook and WhatsApp as network-based social computing tools in collaborative academic writing. WhatsApp, on the other hand, is a mobile-first messaging application that facilitates real-time communication through text, voice messages, and multimedia sharing. While Facebook supports academic collaboration through features such as groups, threaded discussions, commenting, and file sharing, allowing

students to engage in discussions, provide feedback, and coordinate writing tasks asynchronously. Facebook and WhatsApp function as network-based social computing tools that support group cohesion, encourage reflection through peer interaction (Banegas *et al.*, 2020; Kaur and Chowdhury, 2022; Sundari and Febriyanti, 2023; Yuniarti *et al.*, 2023). As described by Kaur and Chowdhury (2022), students were satisfied with the discussion process through the WhatsApp platform because the work became easier and could be done at any time.

e. Supporting Tools

Some technologies greatly support the academic writing process. Software specifically designed to support the scientific writing process, such as Microsoft Word, AcaWriter, and EduNERScore, help students in various aspects of writing, such as drafting paper, managing references, and grammar and plagiarism checking (Knight *et al.*, 2020; Susilo, Mufanti and Fitriani, 2021; Kitjaroonchai and Phutikettrikit, 2022; Jusslin and Hilli, 2024; Li *et al.*, 2024). AcaWriter and EduNERScore are examples of Natural Language Processing (NLP), technology that can recognise sentences that communicate specific rhetorical functions and thus generate automated feedback on writing (Knight *et al.*, 2020; Li *et al.*, 2024). The main functions of this technology are to improve the quality of writing through error detection, provision of corrective suggestions, and ensuring academic honesty. EduNERScore is not merely an individual assessment tool; it is explicitly designed to support and enhance the collaborative process in academic writing, particularly during the peer commenting and group reflection phases. These technologies can reduce plagiarism, improve writing skills, and help students develop a more professional and scholarly writing style.

4.2 Highlighted Instructional Strategies in Technology-enhanced Collaborative Academic Writing Learning

The results of the systematic literature review, presented in Figure 4 below, highlight some strategies as critical features that support students in learning academic writing collaboratively supported by technology (see Appendix B). These strategies become features of collaborative academic writing learning that play roles in the learning process.

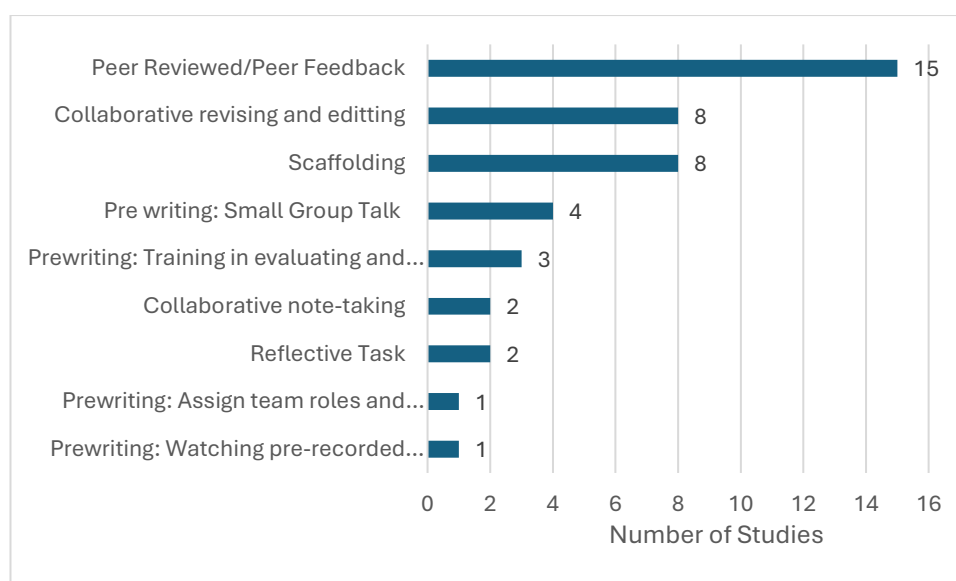


Figure 4: Numbers of Studies Reporting Different Strategies for Technology-enhanced Collaborative Academic Writing Learning

Almost all the types of technology described in this review mediate the instructional strategies employed in collaborative academic writing learning. The identified strategies serve as critical pedagogical anchors across each phase of Technology-Enhanced Collaborative Academic Writing (TECAW) in learning. Importantly, almost all types of technology identified in this review play a mediating role in supporting these instructional strategies in TECAW.

a) Prewriting Phase

Strategies such as assigning team roles, watching pre-lecture videos, and conducting mini-lessons are typically implemented during the pre-collaborative writing stage to build students' preparedness. Classroom-based technologies such as Moodle, Google Classroom, and pre-recorded lecture videos are widely used to deliver

writing instruction asynchronously, share learning materials, assign team roles, and introduce writing tasks (H. Zhang *et al.*, 2022; Burris-Melville and Burris, 2023; Yuniarti *et al.*, 2023). The strategies play a pivotal role in activating students' prior knowledge, establishing shared cognitive frameworks, and preparing students for effective group interaction.

Furthermore, collaborative note-taking was found as a strategy that can enhance pre-academic writing learning. This strategy involves several students recording information together. Collaborative note-taking can enrich the quality of notes produced by students. Students can complement and improve their notes by collaborating, resulting in more comprehensive and detailed notes. The research found that students who take notes collaboratively can produce more complete information than those who take notes individually (Fanguy, Baldwin, *et al.*, 2023). So they tend to generate more new ideas and information, which helps develop students' academic writing skills.

Furthermore, the prewriting stage is sufficient to determine the success of academic writing learning. Implementing prewriting strategies, particularly within small groups composed of peers with varying language proficiency levels, has been found to enhance the quality of students' essays. Such structured prewriting activities help students focus more effectively on the writing task, especially when facilitated through writing prompts that aid in maintaining topic relevance and guiding discussions (Tatiana, 2021). By facilitating early peer negotiation and idea sharing, prewriting strategies ensure that all group members enter the writing phase with aligned understandings, clear purposes, and a collaborative mindset. This cognitive activation in the prewriting stage is fundamental because it lays the groundwork for the higher-order thinking processes required during drafting and revising.

b) In-Writing Phase

The in-collaborative writing stage marks the phase where students begin to construct the initial draft of the manuscript, engaging in real-time collaboration, content development, and iterative refinement of their ideas. Cloud-based word processors, particularly Google Docs and Microsoft Teams, are central to enabling collaborative drafting in real time (Alhazmi and Elamin, 2023; Burris-Melville and Burris, 2023; Fanguy, Costley, *et al.*, 2023; Hati and Bhattacharyya, 2024). Peer drafting and revising activities foster co-construction of knowledge by encouraging group members to provide immediate feedback, challenge each other's ideas, and jointly refine the textual output. This dynamic interaction strengthens critical reasoning and academic argumentation skills while simultaneously nurturing social negotiation and consensus-building as key competencies for academic collaboration (Andheska *et al.*, 2020; Leng, Yi and Gu, 2021; Wang, Zhang and Cooper, 2025). Collaborative study tools such as Padlet and WhatsApp support peer discussion, planning, and negotiation of ideas in synchronous and asynchronous context (Smith, 2022; Yuniarti *et al.*, 2023; Jusslin and Hilli, 2024). Meanwhile, supporting tools such as Microsoft Word and Mendeley assist with drafting in offline settings and managing collaborative citation libraries, respectively (Kitjaroonchai and Phutikettrkit, 2022; Hati and Bhattacharyya, 2024).

In this stage, strategies including providing scaffolding, peer review, and collaborative revising and editing are commonly employed to support active engagement in the writing task. Scaffolding, such as the use of metacognitive prompts, helps students navigate the complexities of academic writing by offering structured guidance (Teng, 2021). These prompts facilitate students' ability to use what they know, transform what they know for academic communication, and structure what they know for the benefit of peers. For instance, giving scaffolding can help students navigate complex writing tasks by offering structured support and guidance throughout the collaborative process. An example of applied scaffolding was using metacognitive prompts (Teng, 2021). Metacognitive prompts in collaborative writing facilitate students' ability to use what they know, transform what they know for academic communication, and structure what they know for the benefit of peers.

c) Post-writing Phase

In the post-collaborative writing stage, reflective tasks are often used to encourage metacognitive thinking and evaluation of both the writing product and the collaborative process. Reflective tasks, including writing reflective logs or group-based self-assessments to evaluate collaboration, writing quality, and individual contributions. Supporting tools like AcaWriter and EduNERScore (based on NLP) provide automated feedback to help students revise and reflect critically on their work (Knight *et al.*, 2020; Li *et al.*, 2024). These activities prompt students to evaluate the quality of their written products, reflect on the collaborative dynamics, and assess their individual contributions to the group effort. Beyond mere correction of writing errors, reflection fosters metacognitive

awareness, allowing students to internalise effective writing strategies and collaborative practices that can be transferred to future academic tasks.

These findings strongly resonate with Vygotsky's (1978). sociocultural theory of learning, which emphasises that knowledge is constructed through social interaction within the Zone of Proximal Development (ZPD). In the context of Technology-Enhanced Collaborative Academic Writing (TECAW), digital platforms and structured instructional strategies provide collaborative spaces where learners can scaffold each other's understanding, co-construct academic knowledge, and progressively develop higher-order writing skills. The integration of technologies and pedagogical approaches, aligned with different phases of the writing process, reflects the principles of collaborative learning envisioned by Vygotsky, affirming that meaningful academic writing development is best achieved through socially mediated activities supported by appropriate technological tools.

The use of technology underscores the imperative for an intentional and pedagogically informed alignment between digital tools, writing phases, and instructional strategies. Rather than adopting a one-size-fits-all approach, educators must strategically curate technologies based on their specific affordances and their ability to support distinct cognitive, social, and metacognitive goals at each writing stage. Such strategic alignment is not merely beneficial, it is essential for cultivating meaningful collaboration, enhancing writing quality, and empowering students to engage deeply in the co-construction of academic writing.

4.3 Limitations and Suggestions

This review has several limitations. The study exclusively collected articles indexed in the Scopus database, which may have limited the diversity of technologies identified and resulted in gaps during the early years of the review period (e.g., 2014, 2015, and 2017). As a consequence, certain emerging technologies or earlier studies published in other reputable databases may not have been captured. Additionally, the review focuses primarily on studies in higher education contexts, which may not fully reflect technological practices in other academic levels or informal learning environments. Based on these limitations, future research is recommended to expand the scope of literature to include multiple databases to capture a broader spectrum of technologies and practices and explore the integration of emerging technologies, particularly artificial intelligence and adaptive learning systems, to better understand their potential in facilitating collaborative writing processes. Furthermore, future investigations should pay closer attention to the design of instructional frameworks that systematically align technologies with the distinct cognitive, social, and metacognitive dimensions of each phase of collaborative academic writing.

5. Conclusion

This systematic literature review highlights the evolving role of technology in supporting collaborative academic writing (CAW) within higher education contexts. The analysis demonstrates that the integration of digital tools is not merely incidental, but rather pedagogically purposeful, aligning closely with instructional strategies that target the cognitive, social, and metacognitive dimensions of student learning.

The findings reveal that technologies such as Google Docs, Moodle, Zoom, WhatsApp, and Microsoft Teams have been extensively utilized to facilitate collaborative writing processes, particularly following the global shift toward online and hybrid learning in 2020. The temporal analysis shows a notable increase in both the frequency and diversity of technologies applied since 2019, reflecting a growing maturity in the methodological and instructional design of Technology-Enhanced Collaborative Academic Writing (TECAW).

Crucially, the review identifies that instructional strategies — including prewriting activities, scaffolding, peer drafting-revising-editing, and reflective tasks — are systematically integrated across the different phases of collaborative writing (prewriting, in-writing, and post-writing). These strategies leverage technology not only as a communication medium but also as an interactive collaborative space and a task-supporting tool, collectively nurturing students' critical thinking, peer negotiation, and self-regulated learning. When technologies are intentionally aligned with these instructional strategies, they significantly enhance the collaborative learning experience and foster deeper engagement with academic writing practices. In conclusion, technology-enhanced collaborative academic writing learning is most effective when technologies, writing phases, and instructional strategies are strategically and pedagogically orchestrated.

Acknowledgement

The authors thank to Lembaga Pengelola Dana Pendidikan (LPDP/Indonesia Endowment Fund for Education) under the Ministry of Finance of the Republic of Indonesia, Indonesian Education Scholarship Program (BPI),

Center for Higher Education Funding and Assessment (PPAPT), and Ministry of Higher Education, Science, and Technology of Republic Indonesia for granting the scholarship and supporting this research.

AI Statement: Artificial Intelligence (AI) tools were not employed in any aspect of this research, including the analysis, writing, or preparation of this article. All work was carried out solely by the authors.

Ethics Statement: Ethics approval is not required in this study.

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Appendix A

Table 2: Technology-enhanced collaborative academic writing learning

Platform	Authors
Moodle	(Jusslin and Hilli, 2024), (Burris-Melville and Burris, 2023), (Pourdana, 2022), (Kitjaroonchai and Phutiketrkit, 2022), (Arroyo González, Fernández Lancho and De la Hoz Ruiz, 2021), (Tatiana, 2021), (Teng, 2021)
Google Classroom	(Sundari and Febriyanti, 2023), (Kaur and Chowdhury, 2022)
Online Learning System	(Mulyati and Hadiano, 2023), (H. Zhang et al., 2022), (Costley and Fanguy, 2021)

Platform	Authors
Pre-recorded lecture videos	(H. Zhang <i>et al.</i> , 2022), (Costley and Fanguy, 2021)
Blackboard	(Motlhaka, 2020)
Electronic Learning Environment (ELO)	(Van Blankenstein <i>et al.</i> , 2019)
Edmodo Mobile Application	(Hosseinpour, Biria and Rezvani, 2019)
Microsoft Teams	(Hati and Bhattacharyya, 2024)
Zoom	(Jusslin and Hilli, 2024), (Burris-Melville and Burris, 2023), (Alhazmi and Elamin, 2023), (Fanguy, Costley, <i>et al.</i> , 2023), (Sundari and Febriyanti, 2023), (H. Zhang <i>et al.</i> , 2022)
Padlet	(Jusslin and Hilli, 2024), (Smith, 2022)
Whatsapp	(Yuniarti <i>et al.</i> , 2023), (Sundari and Febriyanti, 2023), (Kaur and Chowdhury, 2022), (Banegas <i>et al.</i> , 2020)
Google Meet	(Kaur and Chowdhury, 2022), (Pourdana, 2022)
Google Mail	(Kaur and Chowdhury, 2022)
Video Group Conference	(Thirakunkovit and Boonyaparakob, 2022)
Facebook	(Banegas <i>et al.</i> , 2020)
Mendeley	(Hati and Bhattacharyya, 2024)
Microsoft Word	(Jusslin and Hilli, 2024), (Kitjaroonchai and Phutiketrkit, 2022), (Susilo, Mufanti and Fitriani, 2021)
Google Docs	(Burris-Melville and Burris, 2023), (Alhazmi and Elamin, 2023), (Fanguy, Costley, <i>et al.</i> , 2023), (Kaur and Chowdhury, 2022), (H. Zhang <i>et al.</i> , 2022), (Kitjaroonchai and Phutiketrkit, 2022), (Costley and Fanguy, 2021), (Jeong, 2016)
AcaWriter	(Knight <i>et al.</i> , 2020)
EduNERScore	(Li <i>et al.</i> , 2024)

Appendix B

Table 3: Strategies in technology-enhanced collaborative academic writing learning

Strategy	Authors
Prewriting: Training in evaluating and decoding information or mini lesson	(Hati and Bhattacharyya, 2024), (Alhazmi and Elamin, 2023), (Thirakunkovit and Boonyaparakob, 2022)
Prewriting: Watching pre-recorded lecture videos	(H. Zhang <i>et al.</i> , 2022)
Pre writing: Small Group Talk	(Burris-Melville and Burris, 2023), (Yuniarti <i>et al.</i> , 2023), (Sundari and Febriyanti, 2023), (Shayakhmetova <i>et al.</i> , 2020)
Prewriting: Assign team roles and responsibilities	(Burris-Melville and Burris, 2023)
Scaffolding	(Yuniarti <i>et al.</i> , 2023), (Sundari and Febriyanti, 2023), (Mulyati and Hadiano, 2023), (Kitjaroonchai and Phutiketrkit, 2022), (Susilo, Mufanti and Fitriani, 2021), (Teng, 2021), (Knight <i>et al.</i> , 2020), (Van Blankenstein <i>et al.</i> , 2019)
Peer Reviewed/Peer Feedback	(Hati and Bhattacharyya, 2024), (Jusslin and Hilli, 2024), (Burris-Melville and Burris, 2023), (Alhazmi and Elamin, 2023), (Sundari and Febriyanti, 2023), (Mulyati and Hadiano, 2023), (Kaur and Chowdhury, 2022), (Pourdana, 2022), (H. Zhang <i>et al.</i> , 2022), (Smith, 2022), (Banegas <i>et al.</i> , 2020), (Motlhaka, 2020), (Van Blankenstein <i>et al.</i> , 2019), (Hosseinpour, Biria and Rezvani, 2019), (Jeong, 2016)
Collaborative revising and editing	(Hati and Bhattacharyya, 2024), (Sundari and Febriyanti, 2023), (Kaur and Chowdhury, 2022), (H. Zhang <i>et al.</i> , 2022), (Kitjaroonchai and Phutiketrkit, 2022), (Susilo, Mufanti and Fitriani, 2021), (Knight <i>et al.</i> , 2020), (Jeong, 2016).
Reflective Task	(Pourdana, 2022), (Thirakunkovit and Boonyaparakob, 2022)
Collaborative note-taking	(Costley and Fanguy, 2021), (Susilo, Mufanti and Fitriani, 2021).