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Computer-Mediated Collaborative Writing in Language Learning: A Qualitative Research Synthesis

Hajeen CHOI
Bowling Green State University, USA
hajeen.choi@gmail.com

Computer-mediated communication (CMC) technologies have been widely used in second language learning (L2). Now that AI-based tools have gained popularity in L2 writing, it is the right time to reflect on how CMC has contributed to or posed challenges in L2 writing with its unique characteristics. Notably, it enables collaboration among educational participants, unlike Generative AI, where students interact with machines. This study reviewed empirical studies published between 2010 and 2022 to identify the benefits and challenges of computer-mediated collaborative writing in L2 class. The study revealed that computer-mediated collaborative writing had a generally positive impact on students' writing skills and motivation. Some challenges were technological limitations and interpersonal issues inherent in human collaboration. More attention should be given to instructional design and instructor facilitation to overcome these issues. Although this study focused on language learning, some implications can be applied to other computer-mediated collaborative writing projects.

Keywords: collaborative learning, collaborative writing, CMC, computer-mediated communication, L2

Introduction

Computer-mediated communication (CMC) describes the process of generating, exchanging, and perceiving information through various forms of networked communication programs (Romiszowski & Mason, 2013). Many studies have been conducted to assess the effectiveness of CMC technologies in collaborative writing for second language (L2) learners who speak other than a first or native language (L1). (Du et al., 2016; Li, 2018; Miyazoe & Anderson, 2010; Wu et al., 2015; Yen et al., 2015; Zou et al., 2016). Web 2.0 tools such as Wikis, Facebook, and Forum are also CMC tools, and these tools have been adopted in second language (L2) classes to enhance students' motivation and achievement. For instance, Wiki-based programs (i.e., Wikis) such as Wikispaces and PBWorks provide L2 students with a platform for collaborative projects. Wikis have many useful functions such as simultaneous access and version control, which are useful for collaborative works. L2 students can also benefit from the latest technologies to enhance their writing skills through collaborative writing.

Collaborative writing has been broadly used in L2 classes, and CMC technologies facilitate collaborative writing while providing students with more effective and efficient ways of communication than in a traditional classroom (Du et al., 2016; Li & Zhu, 2013). It is widely known that collaborative writing strengthens students' motivation and writing skills through social interaction (Zou et al., 2016). However, social interaction between students often raises interpersonal problems and issues. Technology also causes some concerns when used for educational purposes.

Now that AI-based tools such as chatbot and ChatGPT have gained popularity in L2 writing (Yan, 2023), it is the right time to reflect on how CMC tools have contributed to or posed challenges in L2 writing with its unique characteristics. Notably, CMC tools enable collaboration among educational participants, unlike Generative AI, where students interact with machines instead of humans. Understanding the benefits and challenges of using CMC tools in L2 writing not only improves their effectiveness but also provides insights into addressing the weaknesses of computer-mediated collaborative L2 writing by incorporating other means, including new AI-based tools.

This study aims to offer a synthesized summary of the benefits and challenges associated with computer-mediated collaborative writing in L2 language learning classes by assessing and making connections between existing studies. In doing so, it will offer practical guidelines for ESL/EFL teachers and instructional designers to effectively incorporate CMC tools into collaborative writing courses. The research questions guiding this review are as follows:

1. What are the different forms of collaborative writing?
2. What are the benefits of computer-mediated collaborative writing for L2 learners?
3. What are the challenges and issues involved in computer-mediated collaborative writing for L2 learners?

Definitions

English as a Foreign Language (EFL) vs. English as a Second Language (ESL)

English as a Foreign Language (EFL) is when non-native speakers learn English in their home country, while English as a Second Language (ESL) is when non-native speakers live and learn English in an English-speaking country. Both EFL and ESL learners are termed second language (L2) learners since English is their second language alongside their first (or native) language (L1).

Computer-mediated communication (CMC)

CMC indicates any type of communication that uses computer programs and networked services in both synchronous and asynchronous formats. Messengers and social network services such as Facebook, blogs, and Wikis are examples.

Collaborative writing

Collaborative writing is defined as a writing task in which more than two individuals contribute to a single writing work. It includes both individual writing with peer-review activity and group writing with cooperative or collaborative efforts.

Method

Research Approach and Procedures

This study used qualitative research synthesis method to provide useful information and knowledge on a topic by synthesizing multiple studies selected through purposeful sampling (Drisko, 2020; Suri, 2011). ERIC, an online database of education literature and resources, was used to collect articles about computer-mediated collaborative writing for L2 students. The researcher used ERIC because the target context was formal school learning settings, and ERIC is the authoritative database including full-text educational resources. Google Scholar was also used to extract further articles that met the relevancy criteria.

Search Strategies and Relevancy Criteria

The search was focused on empirical journal articles written in English using a combination of various search terms and keywords pertaining to the target subject (English L2 learners), tool (e.g., computer-mediated communication, computer-mediated language learning, computer-aided language learning, etc.), and topic (e.g., collaborative writing, peer review) with some variations. The search was limited to articles published between 2010 and 2022. This ten-year period was intentionally selected as Web 2.0 tools became actively utilized in language learning during this timeframe. The inclusion and exclusion criteria are outlined in Table 1. After the initial search using these criteria, the researcher thoroughly reviewed the search results to identify articles containing components that could address the research questions. Following iterative refinements by modifying keywords and screening articles, a total of 15 journal articles were ultimately selected for synthesis.

Coding, Analysis, and Summary of Findings

Selected articles were logged and coded into a spreadsheet using 11 dimensions for basic information and methodology. Additionally, three dimensions were used to answer research questions (See Table 2). The forms, benefits, and challenges of collaborative writing from each article were identified and briefly described in the spreadsheet. These descriptions were thematically analyzed to find patterns and themes for each subcategory. Two forms of collaborative writing (individual writing with peer reviews, group writing), three types of benefits (technological, affective, and performance-related), and three types of challenges (technology, group coordination, and age group) were found and summarized in the 'Results' section by reviewing the content of each article more closely.

Table 1
Inclusion and Exclusion Criteria for Article Selection

Category	Inclusion Criteria	Exclusion Criteria
Year	2010 – 2022	Published before 2010
Article type	Empirical, peer-reviewed	Conceptual/theoretical, literature review, non-reviewed
Language	English	Non-English languages
Research context	Formal learning settings (elementary, middle, high, college)	Informal learning settings (e.g., MOOC, social media, etc.)
Subject	English L2 learners (i.e., [1] EFL & [2]ESL learners)	L2 learners of other languages (e.g., Spanish, German)
Topic/focus	Studies include collaborative English writing using CMC tools for peer interaction.	Studies involve English writing but there is no peer interaction (e.g., peer feedback, group writing).
Tool	Asynchronous, text-based CMC tools (e.g., Wiki, Forum, etc.)	Audio & video-based CMC tools; electronic devices without networks

Note. [1] English as a Foreign Language (EFL), [2]English as a Second Language (ESL)

Table 2
Coding Scheme

Category	Subcategory	Codes
Basic information	Author	First author's last name
	Year of publication	2010, 2011, …, 2022
	Empirical	Yes/No
	Study purpose	This was taken from each journal article
Method	Student level	Elementary, middle, high, college
	Student type	EFL, ESL
	Target language	English, English/Chinese, English/Spanish, etc.
	Native language	English, Korean, Japanese, German, etc.
	Data type	Quantitative, qualitative, mixed
	Data collection	Achievement test, interview, survey, text archive, writing assignment, etc.
	CMC Tool	Wikis, Forum, Facebook, blog, etc.
Collaborative writing	Form	These subcategories (form, benefits, and challenges) were summarized and analyzed thematically to answer the research questions.
	Benefits	
	Challenges	

Note. Some of the selected studies were conducted in the context of language exchange programs.

The seven codes for the method category were summarized using a frequency distribution. Since 15 articles are not exhaustive enough to represent all relevant articles published between 2010 and 2022, this distribution is not intended to show the trend of the empirical articles on the given topic but rather to describe the target articles for this research synthesis (See Table 3).

Most studies were conducted with Chinese speaking EFL learners at a college level. There were two studies where EFL learners were collaborating with English speaking students in a language exchange program. Most studies used mixed methods. Pre- and post-test were used to measure students' writing skills before and after collaborative writing. Interviews, survey questionnaires, and text archives were used to collect data. Wikis (Wikispaces, PBWorks) were the most popular CMC tool for collaborative writing. Online forums were also used in many studies for discussion and brainstorming among group members for collaborative writing.

Table 3
Method Used in 15 Articles

Category	Subcategory	Number of Studies
Basic information	Year of publication	2010 (1), 2011 (0), 2012 (2), 2013 (2), 2014 (0), 2015 (1), 2016 (2), 2017 (2), 2018 (1), 2019 (1), 2020 (0), 2021 (1), 2022 (2)
Method	Student level[1]	Elementary (1), middle (1), high (3), college (13)
	Student type	EFL (13), ESL (2)
	Target language[2]	English (15), Chinese (1), Spanish (1)
	Native language[3]	- EFL: Arabic (2), Chinese (9), Spanish (1), Thai (1) - ESL: Creole & Spanish (1), various (1) - Others (CFL, SFL): English (2)
	Data type	Quantitative (1), qualitative (3), mixed (11)
	Data collection[4]	Achievement test (6), interview/FGI (5), observation (2), survey (6), text archive (10)
	Course format	- Web-based, in-person/computer lab (10) - Online, outside of school (5)
	CMC tool	Facebook (1), Google Docs (3), Forum (1), Wikis (10)

Note. [1] One study included students at all levels from elementary to college. [2] Chinese and Spanish were studied by English learners through the language exchange program. [3] Chinese as a Foreign Language (CFL) and Spanish as a Foreign Language (SFL) for native English speakers in language exchange programs.

Thus, collaborative writing is a group activity in which two or more students create a single document together (Du et al., 2016). Peer review and collaborative writing have been drawing attention and getting support from L2 instructors because of the collaborative potential of the latest CMC tools such as Wikis and social media. With these technologies, students can work more easily and simultaneously in groups of three or more than with previous technologies (Kessler et al., 2012).

Results

RQ1. What are the Forms of Collaborative Writing?

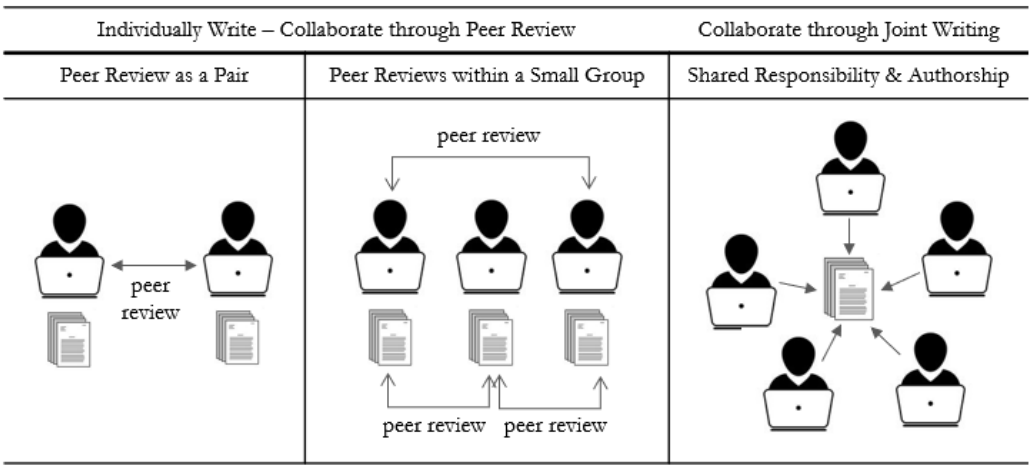
Writing tasks can be implemented individually or within a group. In both cases, collaborative writing is possible through interaction between two students as a pair or among three or more students as a group or team. For individual writing, collaboration is realized through peer review activities. Peer review is an activity in which students provide verbal or written feedback for one another's writing drafts (Chen, 2016). Within a group, collaboration is achieved through shared responsibility and authorship in joint writing (See Figure 1).

RQ2. What are the Benefits of Collaborative Writing Using CMC for L2 Learners?

Previous studies in computer-mediated collaborative writing in language learning classes have revealed three types of benefits: technological, affective, and performance-related benefits (See Figure 2).

Technological benefits. CMC contributes to collaborative writing in three ways: simultaneous editing, convenient writing, and classroom extension. With the advancement of CMC through Web 2.0 technologies, it enables multiple students to simultaneously revise the same text, making the process quicker for both giving and receiving feedback compared to earlier methods (Du et al., 2016; Zou et al., 2016). The web-based CMC tools also provide students with flexibility by allowing them to make formatting changes and to continuously work on writing without waiting for others' responses (Kessler et al., 2012). Additionally, CMC contributes to extended communication and learning beyond traditional classrooms. Students can interact whenever and wherever after school (Alghasab & Handley, 2017; Rahimi & Fathi, 2022; Wichadee, 2010) and can communicate with native speakers beyond borders (Díez-Bedmar & Pérez-Paredes, 2012; Zou et al., 2016).

Figure 1
Different Forms of Computer-Mediated Collaborative Writing



Affective benefits. CMC technologies mitigate face-threatening situations and anxiety for introverted students (Yen et al., 2015). CMC gives shy and reticent students a safer environment to voice themselves. CMC platforms also provide unobtrusive and non-threatening ways of providing comments to students who don't want to hurt others' feelings. While making comments in red pen on the paper seems offensive to some student writers, CMC commenting features such as those available in Google Docs can help student reviewers feel less intimidated (Chen, 2016; Wu et al., 2015). Additionally, CMC increases students' willingness to participate by allowing anonymous communication. The anonymous features of CMC allow student reviewers to be candid in peer review. Honest criticism can result in real improvements in peers' writing (Wu et al., 2015). Finally, CMC influences students' intrinsic motivation and positive attitudes in collaborative writing. Motivation in language learning signifies that students continue to maintain interest and show higher self-efficacy and self-regulation, thereby investing more time and effort in learning the language (Liu et al., 2022; Rahimi & Fathi, 2022; Wichadee, 2010; Zou et al., 2016).

Performance-related benefits. The key benefit of collaborative writing using CMC is the positive effect on students' actual writing skills. Many studies showed that collaborative writing using CMC affected students' writing skills in a positive way through collective scaffolding (Hsu & Lo, 2018; Levrai & Bolster, 2019; Rahimi & Fathi, 2022; Vorobel & Kim, 2017; Wichadee, 2010; Wu et al. 2015; Yen et al., 2015; Zou et al., 2016). Peer review activities also enhance 21st century skills such as collaboration, communication, and critical thinking skills (Kessler et al., 2012; Levrai & Bolster, 2019; Vorobel & Kim, 2017; Wu et al., 2015; Yen et al., 2015). Through the social interaction students engage in during peer review and joint writing activities, students improve their communications skills. Students also automatically enhance their critical thinking skills when they read and critique other students' works. However, there were also studies that showed no significant effects on students' performance (Wu et al., 2015; Yen et al., 2015). In these studies, technology only played a secondary role. Integrating CMC technologies effectively into course design was more important than the attributes of the individual technology (Kessler, 2012). In some cases, students provided incorrect feedback because of their limited language proficiency. For this reason, students preferred instructors' feedback over their peers' (Vorobel & Kim, 2017; Wu et al., 2015).

RQ3. What are the Challenges and Issues Involved in Collaborative Writing Using CMC for L2 Learners?

On the other hand, previous studies have also showed some challenges and issues related to computer-mediated collaborative writing in language learning classes: technology-related issues, group coordination issues, and age and education level-related issues (See Figure 3).

Figure 2

Benefits of Computer-Mediated Collaborative Writing

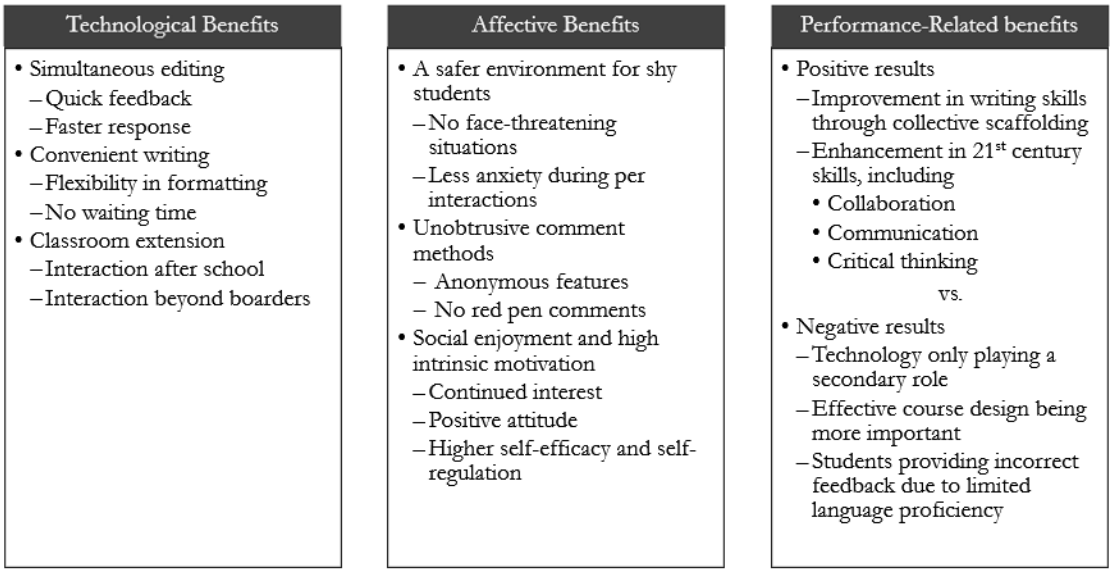
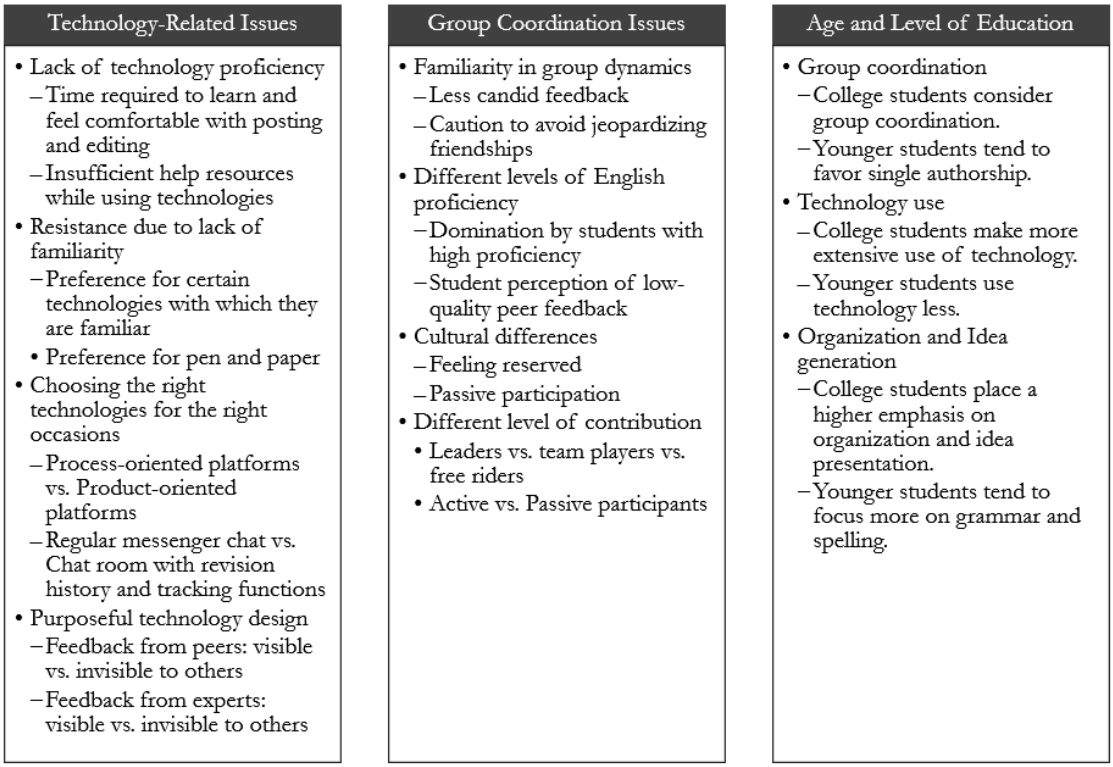


Figure 3

Challenges and Issues of Computer-Mediated Collaborative Writing



Technology-related issues. Technologies are challenging for some students because it takes a fair amount of time to learn and use certain technologies skillfully. Some students feel frustrated if they cannot figure out how to use Wikis to comment and edit, for example. Others have more patience to wait to learn the technology, but they also struggle until they feel comfortable in posting and editing. Researchers indicated that some students were not satisfied with the Wikis because they lacked technical proficiency and did not receive sufficient help while using the technologies (Kessler et al., 2012; Wu et al., 2015; Zou et al., 2016). Students preferred certain technologies based on their familiarity with those technologies. Some students preferred pen and paper for writing tasks over CMC technologies because they were not familiar with the technologies (Liu & Sadler, 2003).

Moreover, technology was not always effective because each technology has its own advantages and disadvantages. Process-oriented Forum was often used in pre-writing stages. On the other hand, product-oriented Wikis and Google Docs were used in both writing and post-writing stages. Pre-writing stages include ice-breaking, brainstorming, and discussion. Thus, Forum was used to establish relationships among group members (Díez-Bedmar & Pérez-Paredes, 2012). When different modes of communication were used, they generated different patterns of interaction. The amount of interaction also varied due to the different features in each technology. For example, the chat room in Google Docs was perceived to be more efficient than the Line online chat room in facilitating group collaboration because it provided revision history and tracked all the changes made by group members (Yeh, 2021).

Lastly, technology design matters for an effective learning outcome. In Wu et al.'s study (2015), students could see feedback from experts as well as other students' feedback online. Since many students borrowed comments from experts and peers, students received the same suggestions repeatedly from different peers. This practice was problematic because it prevented students from receiving constructive feedback from diverse perspectives.

Group coordination issues. Studies have shown that, as expected, group coordination among different individuals can be challenging in collaborative activities. One significant factor in this context is the familiarity and relationships among group members, which have a substantial impact on group dynamics and performance in collaborative writing (Li & Zhu, 2013; Vorobel & Kim, 2017; Wu et al., 2015). Some students may hesitate to provide feedback on their peers' work to avoid offending their classmates or jeopardizing their friendships. When students share a close bond, they tend to become more cautious about creating unnecessary tension.

Group composition not only involves the level of familiarity among group members but also includes various other characteristics that influence interaction patterns and group dynamics. For example, in a study of Li and Zhu (2013), group dynamics, specifically mutuality and equality, were compared among three small writing groups characterized by factors such as gender, English proficiency, familiarity, and class standing. The findings indicated that these factors had distinct effects on shaping group dynamics within each group. Cultural differences also influence group dynamics in collaborative writing. They are among the factors associated with students feeling reserved and being less active in providing peer reviews (Vorobel & Kim, 2017).

Different levels of English proficiency among students also play an important role in collaborative writing. Typically, students with higher proficiency hold more power than those who are less proficient, often taking on a dominant role in sharing the narrative of the writing project as representatives of the entire group (Wu et al., 2015). On the other hand, students with relatively lower proficiency levels tend to be more reserved and cautious about making comments because they are not confident in their English abilities (Vorobel & Kim, 2017). Students perceive their peers' feedback as of lower quality compared to feedback from instructors due to the varying level of students' English proficiency, leading them to prefer instructors' input (Li & Zhu, 2013; Wu et al., 2015).

Lastly, individual students' leadership styles and motivation to collaborate also influence group dynamics. In joint writing tasks, there are typically students who are more active and take on leadership roles, as well as those who are passive and contribute minimally for various reasons (Alghasab & Handley, 2017; Li & Zhu, 2013). Leaders contribute more than their fair share, team players actively collaborate and contribute to the team's work, and lastly, there are passive participants, as well as, free riders (or social loafers), who rarely contribute to group work (Arnold et al., 2012; Levrai & Bolster, 2019).

Age and level of education. Age is an important factor to consider in collaborative writing, as older students typically demonstrate stronger skills in technology use and group coordination. It is noticeable that primary school students rarely prioritize group coordination. A single author is prevalent among primary school students (Du et al., 2016). In contrast, college students place more emphasis on group coordination and tend to focus on organization and idea presentation rather than grammar and spelling. They also make more extensive use of technology than primary and secondary school students, frequently posting and writing on discussion boards. Therefore, it is important

to take into account both students' age and their level of education, as they engage in computer-mediated collaborative writing differently across various educational levels.

Discussion and Conclusion

Studies have shown that CMC technologies provide a positive impact on the performance of L2 students in collaborative writing projects (Kessler et al., 2012; Wu et al., 2015; Yen et al., 2015; Zou et al., 2016). The latest Web 2.0 technologies offer cutting-edge features that enable effective and efficient learning through social interaction (Kessler et al., 2012; Wu et al., 2015; Zou et al., 2016). This social interaction helps students enhance their writing skills, communication abilities, and critical thinking capabilities (Levrai & Bolster, 2019; Vorobel & Kim, 2017; Wu et al., 2015; Yen et al., 2015; Zou et al., 2016). However, not all findings are consistent due to the technological and interpersonal challenges inherent in collaborative activities. CMC technologies have their own limitations despite offering multiple benefits and advantages. Interpersonal issues arising from differences in age, gender, personality, culture, English proficiency, and the relationship between group members create varying dynamics in knowledge co-construction activities for collaborative writing tasks (Li & Zhu, 2013; Vorobel & Kim, 2017).

Careful course design with CMC technologies. Implications based on the findings from this review can be applied to enhance L2 learners' motivation and performance in computer-mediated collaborative writing. Regarding technology, it is important to select the right CMC tools, as each technology has its unique advantages and disadvantages. Combining CMC technologies with face-to-face interaction should be considered for L2 learners because of the importance of nonverbal communication in language learning. Both classroom discussion and online discussions using synchronous communication tools can be useful in the pre-writing stages to establish social bonds among group members. Additionally, the CMC interface must be carefully designed to facilitate effective collaborative writing. For example, peer review or team interaction can be restricted to group members or opened to everyone for vicarious learning within a course. Anonymous peer review should be considered if instructors believe that it would encourage students' active participation, especially among Asian students who may hesitate to provide honest feedback to unfamiliar counterparts (Wu et al., 2015). Therefore, anonymity in CMC could elicit more participation and effective critique from those students. Technological training and assistance before and during the class are essential for both teachers and students to help them become familiar with CMC technologies. When students feel confident and comfortable using technologies, they are more likely to actively participate in computer-mediated collaborative writing tasks (Kessler et al., 2012; Wu et al., 2015; Zou et al., 2016).

Group composition for mutual scaffolding and active participation. When designing collaborative writing groups, instructors need to consider both member and group attributes (Choi & Hur, 2023; Maqtary et al., 2019; Yang et al., 2020). Member attributes include age, gender, personality, and English proficiency, while group attributes encompass homogeneity and familiarity. In forming groups for collaboration, familiarity among group members is important for mutual support in collaborative writing (Wu et al., 2015). This doesn't necessarily mean that students must have pre-existing close relationships with each other to succeed as a team. Rather, it significs the importance of developing positive rapport and building trust among group members before starting collaborative work.

Furthermore, instructors should pair students for peer review and form groups for collaborative writing while considering different levels of students' English proficiency. For collaborative scaffolding, a heterogeneous group in terms of English ability sounds desirable, but this needs more investigation using an experimental design. In the meantime, it is suggested that instructors train students to provide constructive feedback, with a focus on content rather than grammar and spelling, based on a rubric. This is important because many L2 learners lack confidence in their English skills, making them reluctant to provide feedback to their peers. Providing training and clear criteria in the form of a rubric would empower these learners to engage more confidently as reviewers.

To prevent passive participation and free riders, instructors should regularly check in with groups to ensure equal and mutual teamwork. Establishing clear guidelines for collaborative writing activities and factoring peer reviews and collaborative writing into final grades is crucial because most students participate in course activities to receive a good grade (Dennen, 2005). In other words, students are usually extrinsically motivated. Finally, students in different educational levels require different instructional designs for collaborative writing (Du et al., 2016). Primary school students may struggle with communication and coordination in collaboration, necessitating more assistance, intervention, and monitoring from instructors.

In conclusion, computer-mediated collaborative writing offers many benefits for L2 learners. However, there are also challenges related to the use of the technology itself and to the interpersonal nature of collaborative activities. Many studies included in this research synthesis have shown that computer-mediated collaborative writing can increase L2 students' motivation and writing performance. However, these studies also suggest that the benefits can be achieved only if technological limitations and interpersonal issues are overcome through the careful selection and

implementation of CMC technologies, and well-designed peer review or small group activities for collaborative writing tasks. Given that U.S. educational institutions encompass learners with diverse cultural and language backgrounds, many of the findings and implications from this study can be extrapolated to other courses utilizing CMC technologies for collaborative writing projects. Nevertheless, instructors are advised to apply the findings cautiously, as this study primarily focused on investigating L2 learners' collaborative writing in a CMC environment.

Limitations and Future Research

This study, while informative, is not exhaustive as it reviewed only 15 empirical journal articles published between 2010 and 2022. Furthermore, the participants primarily consisted of English L2 learners. Therefore, conducting more comprehensive investigation into computer-mediated collaborative writing for various L2 learners would be beneficial. This could include experimental studies across different proficiency levels of English learners and examinations of various group compositions.

Additionally, computer-mediated collaborative writing holds significant relevance not only for L2 learners but also for students in general, especially as more activities have shifted online following the pandemic. Consequently, future research on the same topic within online group projects or peer review activities with diverse learners would offer valuable insights for online instructors and instructional designers.

Furthermore, comparing writing through interaction and collaboration with peers to writing through interaction with Generative AI will provide meaningful insights into the relative significance of social elements compared to cognitive processes facilitated by machines.

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Note. The articles marked with an asterisk (*) are the ones that have been reviewed for this qualitative research synthesis.