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THINKING ALLOWED

Collaborative writing in L2 classrooms: A research agenda

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Abstract

Research on second language (L2) collaborative writing (CW) has proliferated over the recent decade and will continue to bloom due to the changing landscape of writing and learning in the digital age. This article provides a research agenda on CW in L2 classrooms. We illustrate six research themes for future research inquiry by pointing out the research gap, following a brief review of theoretical frameworks and existing empirical efforts on CW. We then expound on six specific research tasks that we deem to be pressing for this domain to progress, including more attention to multimodal CW, expanded frameworks for analyzing peer interaction and writing products, deployment of underused research techniques and improved research practice, development of CW assessment practice, as well as the inquiry of practitioners' input on CW. We hope to provide guidance for future research endeavors by identifying avenues of investigations on CW and meanwhile contribute to the trajectory of vibrant research on L2 writing and language learning.

1. Introduction

Collaborative writing (CW), as an effective pedagogical practice, has been widely implemented in second language (L2) classrooms over the last decades. Originally defined as 'singular texts/plural authors' (Ede & Lunsford, 1990), CW refers to an activity in which learners interact, negotiate meaning, and make joint decisions throughout the writing process and produce a single text with shared responsibility and co-ownership (Storch, 2013). Previous research has reported many benefits of CW, such as enhancing audience awareness and reflective thinking (Storch, 2012), and providing opportunities to apply newly-learned knowledge (Hirvela, 1999) and pool language resources collectively to co-construct L2 knowledge through scaffolded interaction (DiCamilla & Antón, 1997; Donato, 1994; Swain & Lapkin, 1998). With the development of Web 2.0 tools (e.g., Wikis, Google docs), computer-supported CW, as a writing approach resembling the practice in authentic workplaces (Storch, 2013), enables learners to communicate and jointly write in the L2 beyond time constraints of onsite classrooms.

Currently, the proliferation of social software has brought about fast-growing attention to CW and learning. Lei and Liu's (2019) recent review indicated that applied linguists' interest in CW increased by over seven times between 2005 and 2016, with a notable surge after the publication of Storch's (2013) monograph on CW. Further adding to this flourishing domain of inquiry is Li and Zhang's ongoing book project (under contract with John Benjamins), which presents a collection of up-to-date scholarship aiming to tackle emerging issues relating to CW in varied contexts, with particular attention to technology-mediated solutions to CW.

As a young domain that boasts robust interest and straddles multiple areas (e.g., L2 writing, task-based language teaching (TBLT), computer-assisted language learning (CALL)), a broad range of issues on CW merit further research. This paper presents six research tasks that we deem to be the most pressing and can move the domain forward at both empirical and methodological levels. To

situate the discussion of the selected research tasks, we provide below a brief review of theoretical frameworks and existing empirical efforts on CW prior to delving into each task.

1.1. Theories informing CW

Research on CW has been informed by the interactionist approach (Long, 1983; Swain, 1985, 1993). Extending Long's (1983) work on interaction hypothesis emphasizing comprehensible input through meaning negotiation, Swain (1985) proposed the comprehensible output hypothesis arguing the important role of both spoken and written output in L2 acquisition. Swain's (1993) revised work on pushed output later drew our attention to form-focused CW tasks that push L2 learners to produce language not only comprehensible, but also grammatically accurate. Thus, from an interactionist perspective, peer interaction in CW tasks affords interactionally modified input, corrective peer feedback, and opportunities for producing modified output, which promotes L2 development (Gass & Mackey, 2006). The interactional processes in CW tasks also allow learners to notice the gap between their interlanguage and the target language, test language hypotheses, and pay more attention to form (Torres & Cung, 2019; Yilmaz, 2011).

The other theoretical approach that has enlightened CW research is the sociocultural theory (Vygotsky, 1978), which posits that language learning is socially situated via interactions with experts and/or peers. This theoretical approach towards CW is underpinned by the notion that language and social interaction facilitate learning in the learners' Zone of Proximal Development (ZPD). Specifically, collaborative dialogue occurring in CW tasks provides a site for learners to elicit and provide scaffolding—the finely tuned assistance leading to L2 learners' language development within their ZPD. Proposing 'collective scaffolding' that occurs during peer interaction, Donato (1994) noted that learners are simultaneously individually novices and collectively experts who pool resources together to resolve linguistic issues and jointly construct L2 knowledge. Meanwhile, language serves dual functions during the language learning process: a means for communication and a cognitive tool for mediating knowledge co-construction (Antón & DiCamilla, 1999; Swain & Lapkin, 1998).

In addition, we have found research on CW undergirded by the activity theory (Leont'ev, 1981) and activity system (Engeström, 1987, 1999). Activity theory posits that human purposeful activities are driven by needs or motives. Needs, either biological or culturally constructed, become motives when they get directed at a specific object, and motives are then realized in specific goal-directed actions (Lantolf, 2000; Leont'ev, 1981). Activity theory helps elucidate the role of motive/goal in construing interactional processes and variations in peer interaction (Li, 2014; Li & Zhu, 2017a). In L2 research, Donato (1988) originally discussed the variability in small groups' interactional behaviors from the perspective of activity theory: the goal of a loosely-knit group was simply to complete the task while the collective group shared the goal of completing the task together. Moreover, based on Vygotsky's (1978) notion that language learning is a mediated process that involves mediation by artifacts, self, and others in social interactions (Lantolf, 2000), Engeström (1987) later proposed the Activity System model and explained that individual actions and goals were interconnected with other sociocultural factors. He identified the activity system as a collective unit composed of tools, subject, object, outcome, community, division of labor, and rules. This framework provides a new lens to examine the complex nature of students' participation and interaction in CW tasks, viewed as a collective, artifact-mediated, and object-oriented activity system (Li, 2021).

1.2. Current status of scholarship

Informed by the above-mentioned theoretical frameworks, research on CW has been increasingly conducted in diverse L2 learning contexts, across modes, tasks, and language learning environments. One main strand of research on CW addressed interaction/writing processes, including the analyses of language-related episodes (LREs), revision behaviors, and relationships formed during interaction (e.g., Bradley et al., 2020; García Mayo, 2002). Of note, drawing on the indexes of 'equality' and 'mutuality'

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(Damon & Phelps, 1989), Storch's (2002), models of dyadic interactions during CW have been adopted/adapted in many studies in both face-to-face (F2F) settings (e.g., Watanabe, 2008; Watanabe & Swain, 2007) and computer-mediated communication (CMC) settings (e.g., Li & Kim, 2016; Li & Zhu, 2013). The second main strand of research explored writing performance and writing development through either comparing CW with non-CW tasks (e.g., individual writing, peer review) or operating CW as a pedagogic intervention (e.g., Bikowski & Vithanage, 2016; Hsu & Lo, 2018; Qiu & Lee, 2020). Research in this line, similar to other L2 writing research, widely relies on the syntactic complexity, accuracy, lexical complexity, and fluency (CALF) framework to analyze the written products of CW (Housen et al., 2012; Zhang & Plonsky, 2020).

The third strand of research addresses factors that mediated CW, including task factors (e.g., task type, task mode, language use) and learner factors (e.g., proficiency level, sociocultural backgrounds) (García Mayo, 2002; Kim & McDonough, 2011; Zhang & Plonsky, 2020). For example, Alegría la Colina and García Mayo (2007) looked into the effects of task types (form-focused tasks vs. meaning-focused tasks) on learners' attention to form in CW, while Fernández Dobao (2012) examined how group size influenced L2 written output and peer interaction. Zhang (2018) compared the effects of first language (L1) and L2 use in CW and found a benefit for L1 use in mediating the collaborative dialogue and eliciting linguistic features of higher complexity. Regarding computer-based CW tasks, Cho (2017) and Li (2021) drew on Engeström's (1999) activity system and discovered multiple mediating factors by analyzing essential components of the system (e.g., mediational means, outcome, rules, division of labor). The fourth notable strand of research is students' perceptions (Arnold et al., 2012; Aydin & Yildiz, 2014; Ducate et al., 2011; Kessler & Bikowski, 2010; Li & Zhu, 2013; Shehadeh, 2011; Storch, 2005), including perceived benefits (e.g., developed communication skills, improved language and writing skills, and enhanced audience awareness) and challenges of CW (e.g., learners' limited ability to communicate in L2, difficulties in maintaining co-ownership, and unequal participation from group members).

As demonstrated in the above-mentioned research, CW possesses immense potential for L2 learning and writing development in various contexts, which is subject to moderation by a range of factors. It is apparent to us that this domain has shifted away from answering the question of Whether CW is beneficial to explore the question of HOW to maximize the potential of CW in varied learning contexts with differing learner populations and tasks. With this overarching goal in mind, researchers cannot disregard two traits characterizing this domain of inquiry, both of which simultaneously complicates and enriches the empirical and pedagogical practices of CW investigations: (a) rapidly changing technologies and what they constantly afford in the digital age and (b) the fact that CW has drawn upon analytic frameworks and approaches from multiple sub-fields of L2 research, including L2 writing, TBLT, CALL, and L2 acquisition (SLA) (Zhang & Plonsky, 2020).

In light of the inherent intricacies and the dynamic development in this area, we illustrate below six themes for future research inquiry by pointing out the research gap and then detailing what tasks need to be done and how. We believe that moving this area forward involves tackling pressing empirical questions and further developing existing analytic frameworks in order to meet new challenges in the digital era. We, therefore, discuss research tasks regarding six themes from empirical, methodological, and pedagogical perspectives. Our hope is to enhance researchers' understanding of this changing landscape of CW and motivate them to contribute to this burgeoning field.

2. Research tasks

We propose below six research tasks that will help shape the research agenda on CW in L2 classrooms based on prominent research studies in this field. The six tasks represent the areas that deserve researchers' wider attention but may not be comprehensive. In each of the following subsections, we present an overview of the research theme prior to presenting the specific research task. In illustrating each task, we further pinpoint the research gap following a brief review of the most pertinent research and then suggest the specific research agenda for tackling the task under discussion.

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2.1. Research theme: CW tasks

Tasks are fundamental in L2 writing classrooms as they determine the learning experiences and writing activities that learners engage in (Hyland, 2019). A wide variety of writing tasks and genres have been implemented in CW research. Regarding F2F CW research, a form-focused task (i.e., dictogloss) and a meaning-focused task (i.e., narrative writing) have been the most frequently examined, followed by text reconstruction, argument, descriptive, and data commentary (Zhang & Plonsky, 2020). In terms of the literature on computer-mediated CW, expository writing, argumentative writing, and narrative writing have been the most often employed, whereas multimodal writing tasks, such as poster/brochure and graphic writing, have merely started to gain researchers' attention (Zhang et al., 2021b). That is, the majority of CW tasks remain text-focused; monomodal writing dominates the CW literature, even in CMC contexts that inherently entail multimodality. Given the multimodal realities and radical changes in the communication environment, writing has been reconceptualized as multimodal composing, which provides writers with opportunities to deploy multiple resources (e.g., linguistic, visual, audio, gestural, and spatial) to make meaning, construct knowledge, and express self-identity (Belcher, 2017; Li & Storch, 2017; Zhang et al., 2021a). Despite the increasing implementation of digital multimodal writing in L2 classrooms, research on multimodal CW is at the infancy stage. A CW approach towards digital multimodal texts likely has potential to facilitate the development of learners' collaborative skills and L2 digital literacy skills, both deemed essential for completing authentic tasks that learners may encounter in the digital world. Therefore, Research task 1 is devoted to addressing multimodal CW, defined as a pedagogical activity in which two or more learners deploy digital tools and multiple semiotic resources to jointly compose one single multimodal product.

Research task 1:

Explore L2 learners' collaborative multimodal composing processes and examine the collaboratively-produced multimodal writing in comparison with the individually-produced multimodal writing.

To our knowledge, only a few publications (i.e., Hafner, 2011; Smith, 2019; Vandommele et al., 2017) reported on the implementation of multimodal CW in multilingual classrooms, focusing on either the writing process or the writing products. Informed by sociocultural and socio-semiotics theoretical frameworks, Smith (2019) innovatively examined how three pairs of adolescent multilingual learners collaboratively worked on three multimodal composing projects (i.e., informational webpage, hypertext literary analysis, audio letter) involving the use of texts, videos, and images. Drawing on triangulated data sources including screen capture, video observation, and perception data, Smith (2019) identified three distinct types of peer interactions: designer and assistant, balanced division, and alternating leader. To take another example, focusing on the effect of multimodal CW on writing development, Vandommele et al. (2017) investigated Dutch as L2 students' in-school and out-of-school multimodal CW practices and found that students in both learning contexts demonstrated writing development as gauged by text measures, such as linguistic complexity, lexical diversity, and text length.

Although Smith (2019) sheds light on the group dynamics of dyads working on multimodal CW projects, it remains unknown how learners may collaboratively deploy multiple semiotic resources to complete multimodal CW tasks. To better illustrate the interaction between multimodality and collaboration, future research needs to investigate how L2 learners co-construct multimodal writing by jointly orchestrating semiotic resources. Smith et al. (2017), although focusing on INDIVIDUAL bilingual students' multimodal composing, proposed 'codemeshing timescape' to track the iterative multimodal composing process, which can provide a valuable analytical framework. Researchers need to first collect the triangulated data sources such as screencast recordings, observations, and discussion/ writing records archived in the technology system used in the multimodal CW tasks. They could adopt/adapt the construct of 'codemeshing timescape' as a starting point to analyze how L2 learners collaborate during multimodal composing processes (e.g., internet search, image design, audio remix,

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codeswitching between languages). Such inquiries would advance our understanding of how learners draw on different individual resources and provide collective scaffolding through multimodal CW activities.

Following previous studies addressing two indexes of peer interaction (i.e., equality and mutuality), researchers need to consider how to operationalize equality and mutuality in multimodal CW tasks. The comparison of SELF-INITIATED and OTHER-INITIATED writing change functions and comparison of INITIATING and RESPONDING language functions used in previous studies (e.g., Li, 2013; Li & Kim, 2016) may provide insights into the nature of collaboration. Departing from the analytical approach to examining peer interactions in F2F CW, Li and Kim (2016) proposed an innovative analytical framework considering three connected elements essential for computer-based CW, namely language functions during the online discussion, writing change functions during text co-construction, and scaffolding strategies during the online collaboration process. To explore the multimodal CW process, researchers may adapt such analytical frameworks, for instance, to develop the coding scheme of writing change functions (i.e., adding features distinctive to multimodal writing such as image addition) to track the multimodal CW processes.

Much previous research on monomodal CW has examined L2 learners' languaging process, and it will be important to explore how multimodal CW tasks may affect L2 learners' languaging (Lim & Kessler, 2021) using the traditional coding schemes of LREs reported in previous studies (e.g., Storch, 2008; Storch & Wigglesworth, 2010; Zhang, 2019a), involving different foci (e.g., form, lexis, mechanical, discourse), level of engagement (i.e., elaborate and limited), and resolution (e.g., resolved, correctly resolved, and unresolved). Through examining different aspects of LREs, we would know whether or not learners are less engaged in language issues or pool less linguistic resources as they have non-linguistic resources to communicate their meaning. Future research can further probe into the questions on interaction in multimodal CW: How would collective scaffolding be manifested differently in multimodal CW compared with monomodal CW? In other words, how would pairs or small-group members bring their different expertise and pool semiotic resources together to resolve other issues in writing (e.g., multimedia and visual effects) in addition to linguistic issues?

Moreover, researchers need to draw on interdisciplinary knowledge (e.g., social semiotics, SLA, L2 writing) to develop analytical frameworks to examine products pertaining to multimodal CW tasks. For instance, informed by the knowledge of metadiscourse (Hyland & Hse, 2004) and visual communication (Kress & van Leeuven, 1996), D'Angelo (2010) developed a useful framework to analyze individual multimodal texts (academic posters in focus) that consisted of interactive resources (e.g., information value, framing, connective elements, graphs, fonts) and interactional resources (e.g., salience, size of frame, and perspective). While extending the application of metadiscourse to textual analysis, D'Angelo (2010) advanced our understanding of metadiscourse as realized through both textual and visual modes.

Regarding the inquiry of the role of multimodal CW for language learning, Vandommele et al. (2017) investigated the positive effects of multimodal CW on L2 writing development via a quantitative study. However, this study did not compare the CW products and the individual writing products, and the distinct role of collaboration was thus barely revealed. To bridge the gap, researchers can compare the textual qualities (e.g., complexity, accuracy, fluency, coherence) of collaboratively produced multimodal writing in comparison with individually produced multimodal writing. Addressing the multiple areas about multimodal CW as discussed in previous sections will definitely enlighten the work on CW tasks in the digital era.

2.2. Research theme: Peer interaction and collaboration

As a domain largely informed by sociocultural theories underscoring the value of collaborative dialogue, CW research has paid immense attention to learner interaction that may take various forms depending on the mode of interaction, namely F2F interaction, online chats, discussion posts, and

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online commenting (Storch, 2019). Thus far, researchers have mainly deployed three approaches in analyzing learner interaction in CW: (a) analyzing the focus of the interaction to discern what aspects of a task learners have attended to or prioritized (e.g., Elola & Oskoz, 2010; Storch, 2005; Zhang, 2021); (b) identifying the nature of collaboration in order to better construe learner performance in CW (Li & Zhu, 2017b; Storch, 2002); and (c) detecting language learning opportunities afforded in CW via analyzing learners' attention to form (mainly operationalized as LREs) (e.g., Fernández Dobao, 2012; Kessler et al., 2012; Li, 2020; Watanabe & Swain, 2007). One salient pattern is that despite the great potential of CW for eliciting learners' attention to form as reported in F2F CW literature (e.g., Fernández Dobao, 2012; Kim, 2008; Storch, 2008), computer-mediated CW research paid limited attention to this regard. While this may relate to the fact that learners' attention to form is more difficult to capture in CMC settings (Storch, 2019), it remains less clear whether CW implemented in CMC has similar potential for promoting the co-construction of linguistic knowledge. Answering this question is highly pertinent given the growing needs for computer-mediated tasks in language classrooms in the digital age.

Additionally, while existing approaches of analyzing peer interaction in CW have taken us this far in understanding group dynamics and L2 learning opportunities, we lack frameworks that can afford a fuller picture of how peer interaction in CW promotes the development of multiple types of knowledge needed for writing. Hyland (2019) identified five types of L2 learners' knowledge for effective writing, namely knowledge of content (i.e., what to compose), system (i.e., lexico-grammar, formal conventions), process (i.e., planning, drafting, and composing), genre (i.e., crafting socially recognized texts), and context (i.e., understanding reader expectation, beliefs, and cultural preferences). The LREs framework addresses how learners co-construct knowledge of the linguistic system, and the frameworks for analyzing the focus of interaction (e.g., Storch, 2005) touch upon how learners co-construct knowledge of content in CW. Nevertheless, there is an absence of frameworks for understanding how learners collectively deploy or develop knowledge of the writing process, genre, and writing context. Research task 2 is devoted to tackling the above-mentioned issues.

Research task 2:

Explore the potential of computer-mediated CW for eliciting attention to form and expand frameworks for analyzing learner interaction in CW.

Only a few studies to date have examined learners' attention to form in computer-mediated CW tasks, yielding mixed findings. Rouhshad and Storch (2016) examined how ESL learners who were explicitly instructed to provide peer feedback negotiated forms in F2F and synchronous CW tasks. Their results indicated, compared with F2F CW, learners generated and successfully resolved fewer LREs when collaboratively composing a decision-making essay synchronously in Google Docs, a pattern that might relate to learners' less collaborative relationship formed in CMC settings. In Kessler's (2009) study, English as a Foreign Language (EFL) pre-service teachers jointly worked on a class wiki writing project centered on defining/explaining the term CULTURE. The results showed that the participants initiated some attention to form, but tended to prioritize meaning and style as they deemed web-based CW 'less form demanding' (p. 84). Hsu (2019) conducted a study on wiki-based CW, in which EFL students collaboratively wrote an expository essay in pairs/small groups based on their self-selected topics and they were required to negotiate content, organization, and language of their writing. It was found that EFL learners paid much more heed to linguistic forms than to content and organization. The inconclusive findings and the fact that predominantly meaning-focused tasks (i.e., decision-making, reflection, expository writing) have been investigated pointed to a need for more research in this regard.

One of the ways to implement this research task is to adopt form-focused CW tasks (e.g., text reconstruction, dictogloss) and examine learners' attention to form during such tasks across modes (i.e., F2F, CMC). Given the different modes of interactions, it is worthwhile to investigate both

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text-based interaction (mainly in asynchronous CMC tasks) and audio/video-based interaction (usually in synchronous CMC tasks) to further understand whether the properties of different modes or technologies may influence the potential of CW for generating attention to form. A critical part of this investigation regards the identification of attention to form in CMC settings. Different studies have opted to operationalize attention to form in computer-mediated CW differently: while both studies researched wiki-mediated CW, Kessler (2009) considered learners' edits on the lexico-grammar of texts as attention to form, whereas Hsu (2019) focused on learners' contemplation on language use (LREs) in chats and comments. Undoubtedly, attention to form may take various forms and a one-size-fits-all approach may not be the ideal solution. Future research is encouraged to clearly define their operationalizations of attention to form and employ comparable measures when possible, which is to help paint a clearer picture for this line of inquiry. Also, the methodological innovation (e.g., eye tracking) would provide additional insights into learners' attention to form.

To analyze learner interaction in CW, the LRE analysis and focus of peer interaction (McDonough et al., 2016; Storch, 2005) are useful frameworks. However, additional frameworks are needed to understand how learners co-construct other types of knowledge, especially genre knowledge, knowledge of composing process (e.g., writing strategies), and knowledge of writing context. Tardy and Gou (2021) proposed the genre-related episode (GRE) as a supplementary framework for analyzing how learners attend to genre-related aspects of a CW task. This new model can be useful for CW research that introduces unfamiliar genres to learners and research that employs CW as a task for discourse co-construction. This field can also benefit from other frameworks that account for how learners, especially intermediate to advanced L2 learners at postsecondary levels, assist each other to discover the writing context (e.g., reader expectation, beliefs, cultural preferences), co-build knowledge of writing process, and utilize non-linguistic semiotic resources should tasks are designed to be multimodal.

2.3. Research theme: Written products

As a sub-domain developed out of L2 writing, CW has a tradition of analyzing written products. In scoping reviews of the F2F CW and computer-mediated CW research (Zhang & Plonsky, 2020; Zhang, Gibbons, & Li, 2021), we found that collaborative texts in both F2F and CMC settings have been predominantly measured via text quality and the syntactic CALF framework. While the CALF measures have been a main framework for understanding learner texts in L2 research, the over-representation of these measures raises potential concerns: (a) insufficient attention to capturing text features that may be attributable to the collaborative nature of the tasks (i.e., involving two or more composers), (b) a lack of measures for capturing text features associated with the affordances of CMC settings (e.g., multimodal features, more diverse genres), and (c) scare attention to a discourse approach towards writing (mostly applicable to adult learners in post-secondary academic settings). In other words, overly relying on CALF metrics risks overlooking other aspects (e.g., cohesion, discoursal/rhetorical/multimodal features) of learners' co-constructed texts. Additionally, because existing metrics of syntactic complexity in this area relied on T-unit-related metrics (i.e., global complexity) and subordination-related measures (i.e., clausal complexity) (see Zhang & Plonsky, 2020 for further discussion), it leaves the phrasal complexity of the texts under-examined—a dimension that both L2 writing researchers (e.g., Johnson, 2017) and corpus linguists (e.g., Biber et al., 2011; Biber et al., 2020) have identified as crucial for learner texts in academic settings. In sum, to better understand written products in future CW research, it is pivotal that researchers embrace a broader view of learners' collaborative products and develop or incorporate additional frameworks for analyzing them. Research task 3 is devoted to addressing this gap.

Research task 3:

Employ a broader framework for analyzing collaborative products and explore the connection between CW products and processes in computer-mediated contexts.

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As discussed above, the CALF framework and text quality are unable to fully capture features of learners' co-constructed products. In this research task, we urge researchers to consider additional constructs/approaches in analyzing the written products in CW depending on the nature of tasks employed and the research questions asked: (a) coherence; (b) rhetorical/discoursal aspects; (c) phrasal complexity via corpus methods or manual coding; and (d) measurement of multimodal texts.

To begin with, coherence showing unity and continuity of discourse can be an essential indicator for the quality of CW; successful jointly produced texts should be coherent overall in meaning and purpose; the lack of co-ownership and collective cognition can lead to the writing of poor quality in coherence (Li & Zhu, 2017b). While a moderate portion of CW studies may have marginally touched upon coherence by incorporating this parameter into text quality rubrics, we argue that coherence deserves to be addressed as a separate construct in CW, especially in cases where the collaborative texts are at a higher risk of being incoherent due to collaboration (e.g., a text co-composed by multiple learners; lengthy texts comprising of multiple sections; asynchronous co-composing with limited interaction). For instance, in analyzing research proposals by small groups of graduate students in an English for Academic Purposes (EAP) class, Li and Zhu (2017b) deployed the notion of coherence breaks, referring to missing of consistent flow and of logical sequencing of ideas (Wikborg, 1990), to examine the coherence of the products. Future research examining similar genres is encouraged to consider adopting this framework. Alternatively, a holistic six-band rubric on coherence and cohesion developed by Kuiken and Vedder (2017), which was tested to be reliable, may also be an option for measuring this construct.

Second, an analysis of the rhetorical (e.g., rhetorical moves) and discoursal features (e.g., authorial voice, metadiscourse) in learners' collaborative texts may provide valuable insights when relevant to the research goals and tasks. A handful of studies have attended to such aspects, including Li and Zhu (2017b) who analyzed the presence/absence of essential rhetorical elements in research proposals, Kuteeva (2011), who examined interactional metadiscourse (e.g., engagement markers, hedges, attitude markers) to understand the writer-reader relationship in wiki-based CW, and Zabihi and Bayan (2020), who studied multilingual learners' authorial voice in collaborative argumentative writing tasks. For research that deems CW as a site for discourse co-construction and/or identity co-construction, the above-mentioned constructs provide additional perspectives to understand written products.

Another construct/approach that has not received due attention is phrasal complexity and the associated corpus methods for analyzing it. The importance of phrasal complexity in L2 writing development has been consistently supported via corpus investigations (e.g., Biber et al., 2011, 2020). In the domain of CW, Zhang (2018, 2021) reported that while traditional complexity metrics failed to capture linguistic variation in collaborative texts produced in two task conditions (L1 use vs. L2 use), a corpus-based approach was able to detect that texts in the L1 use condition boasted of nominal features representing high phrasal complexity. The advantage of corpus methods in capturing syntactic variation in post-secondary learners' collaborative texts over traditional T-unit-related metrics was also confirmed in Zhang and Chen's (under review) study on the effects of assessment approaches in synchronous CW tasks. Given the solid evidence supporting the value of analyzing phrasal complexity, future research exploring CW in academic settings can benefit from incorporating this construct. Methodologically, this can be implemented in two fashions. Researchers who are interested in a fuller range of linguistic variation in CW can first have the texts annotated for grammatical properties using corpus tools such as Biber tagger (Biber, 1988) and TagAnt (Anthony, 2015), and then examine a full range of lexico-grammatical features that corpus research has found to be associated with linguistic complexity at the clausal, intermediate, and phrasal levels (Biber et al., 2014). Alternatively, researchers can adopt a more parsimonious method by concentrating on a set of linguistic features that are indicative of phrasal complexity. Those features, as noted in a series of work by Biber and colleagues, include attributive adjectives, nouns as noun modifiers, prepositional phrases as noun phrases, and appositive noun phrases (Biber et al., 2020). With limited features to analyze, the latter approach may work with manual coding without corpus tools and training for research that has a manageable sample size.

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Furthermore, as previously discussed, many computer-mediated CW tasks can be multimodal by nature due to the high accessibility of varied semiotic resources, which necessitates the measurement of non-linguistic semiotic resources in collaborative multimodal texts. We encourage efforts in developing frameworks for coding multimodal semiotic resources in CW while multimodal CW has just started to receive attention. We are positive that the measurement of non-linguistic resources will be warranted in future studies and that frameworks used for DMC (e.g., D'Angelo, 2010, 2016; Hafner & Ho, 2020) can be a highly useful resource in this regard.

Building upon a broader view of learners' collaborative texts, this line of research can be further extended by more inquires on the connections between CW/interaction process and collaboratively-produced texts in CMC settings in order to better understand how writing performance or development may be triggered by the collaborative interaction of particular foci. While this has been largely researched in F2F CW (e.g., Fernández Dobao 2012; McDonough et al., 2016; Zhang, 2019b), the link between collaboration and texts has only be examined in a few studies in computer-mediated CW (Abrams, 2019; Li & Zhu, 2017b; Oskoz & Elola, 2014). Taken together, a series of research questions deserve exploration. For instance, what measures should be deployed to fully evaluate CW products in line with the nature of writing tasks and learning goals (both curricular goals and students' individual goals)? To what extent are features of the writing products (e.g., rhetorical/discoursal features) attributable to the task characteristics, peer interaction, learner characteristics/goals, or the interplay of all three? In what ways can peer interactions lead to the production of high-quality written texts? Answering such questions would better guide us in pedagogical practices.

2.4. Research theme: Methodological choices and practice

CW research in the past decades has benefited immensely from employing diverse research methods, including quasi-experimental, case study, action research, descriptive, and grounded theory (Zhang & Plonsky, 2020; Zhang et al., 2021). They allowed researchers to develop fundamental theories, discern how different variables have influenced the potential of CW, and propose empirically-grounded pedagogical recommendations. One notable pattern is the limited portion of interventionist research in computer-mediated CW research (Zhang et al., 2021). Being cognizant of the vast logistic challenges that an experimental research design may present in CMC settings, we argue that more interventionist research that conscientiously controls confounding variables is to further advance our understanding of computer-mediated CW across task conditions and learner populations.

When zooming in on specific data sources, CW research has mainly relied on texts, recorded or online stored peer interaction, surveys, and semi-structured interviews. Occasionally, researchers employ reflection or journaling to collect introspective data in tapping into learners' task perception (e.g., Wang, 2014). Other introspective techniques and emerging techniques, which are useful for tapping into learners' cognitive and thought processes (Polio & Friedman, 2017), are rarely represented in this domain. Aside from research methods and techniques, Zhang and Plonsky (2020) and Zhang et al. (2021) also identified a few areas of research practices that are in need of improvement for this domain to progress: (a) overwhelmingly diverse metrics for CALF across studies, (b) insufficient reporting of reliability for data manual coding, and (c) an underuse of validity strategies in qualitative CW research. This research task aims to push this domain to forge ahead from a methodological perspective.

Research task 4:

Expand current research methods/techniques and improve research practices.

Prior to underscoring the value of an experimental research design for computer-mediated CW research, we must note that there has been emerging interventionist research in this sub-domain, with the majority of them comparing computer-mediated CW with similar tasks such as F2F CW

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or individual writing (e.g., Bikowski & Vithanage, 2016; Jiang & Eslami, 2021; Rahimi & Fathi, 2021). Since prior studies have quite consistently found that computer-mediated CW is beneficial for learners, the next question to be tackled is how its benefits (e.g., improved writing ability, better written performance) may be influenced by task variables (task design, task implementation, technology type) and learner variables (e.g., proficiency). An experimental research approach is useful in that it allows researchers to manipulate variables, guard against confounding variables, and select target features as needed. This, by no means, suggests that an interventionist design is superior to other research methods (e.g., case study) in pursuing this line of inquiry. We merely hope to emphasize that this underrepresented approach deserves more attention in computer-mediated CW research and can complement the existing empirical landscape. In addition, much needed are more longitudinal studies (more than a semester long) examining the effect of (computer-mediated) CW on L2 learners' individual writing development, and empirical studies conducted in the K-12 contexts, given the dearth of available research on non-adult populations (Zhang et al., 2021b).

We also identified three under-employed research techniques that entail great potential for CW research: stimulated recalls, think-aloud protocols, and eye-tracking. As a technique that taps into one's thought processes during a task, stimulated recalls were used in Brooks and Swain (2009) to detect learners' contemplation on linguistic forms and revisions during CW tasks. This technique can also be used to investigate learners' collective decision-making and problem-solving processes during the collaborative activity. Screen captures, recordings of peer interaction, or revision histories stored online can serve as the stimuli for eliciting the data. The think-aloud technique, which involves participants verbalizing thought processes as they concurrently engage in a task, has been broadly used in L2 writing research (Polio & Friedman, 2017). While it is logistically less feasible to have learners think-aloud in F2F CW tasks, this technique can be employed to shed light on learners' revision behaviors, attention to form, and writing strategies when learners participate in online CW tasks in which the peer interaction is non-verbal (e.g., text-based chats, discussion posts). Eye-tracking, a technique that aims to track eye movements to discover learners' cognitive processes, could be a useful technique for researching CW tasks of different cognitive demands. For instance, a study can utilize eye-tracking to investigate whether learners working in dyads are capable of managing writing tasks of higher complexity than learners who work individually.

Last, in order to progress as a field, it is crucial that future CW research implement improved research practices, especially in choosing CALF measures, reporting manual coding of target features, and incorporating validity strategies. First, the vast heterogeneity in the CALF metrics for evaluating learners' written products, which has characterized both F2F and CMC CW research (Zhang & Plonsky, 2020; Zhang et al., 2021), thwarts the development of this domain in that findings across empirical inquiries are often not comparable, rendering it difficult to aggregate research evidence to inform pedagogic decisions. Looking ahead, a more lucid description of choices for CALF measures and improved consistency across studies examining similar learner populations and task types/genres are in order. Moreover, this field can benefit from enhanced reporting of reliability estimates for the manual coding of L2 features, especially for features reported to have been overlooked in this respect, including syntactic complexity, accuracy, LREs, and revisions (Zhang & Plonsky, 2020; Zhang et al., 2021). Such improvement is necessitated to facilitate the meta-analytic synthesis of empirical investigations and boost the interpretability of research findings and research rigor in this promising area (Plonsky, 2013). Another important way to enhance research rigor is to promote the incorporation of validity strategies in qualitative research. Commendably, qualitative CW research often draws upon multiple data sources to triangulate the research, but the adoption of other validity strategies (e.g., bias clarification, member checking, a thick description) is far from ideal.[1] Future qualitative inquiries should consider clarifying potential researcher bias and more frequently incorporating researcher reflexivity, offering participants opportunities to comment on half-polished narrative based on interview data, and affording detailed descriptions of research contexts and acts whenever possible (Creswell & Creswell, 2017).

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2.5. Research theme: CW assessment

In addition to the anticipated advancement from a research perspective, we believe that CW can benefit from pedagogical considerations. Thus, the themes we will discuss next are highly related to pedagogy. Despite the widespread implementation of CW tasks in L2 classrooms, the assessment of CW has not yet received due attention. As Li (2018) pointed out, little available research on CW addressed the topic of CW assessment. As noted in Section 2.3, previous literature has predominantly focused on assessing CW products. Assessment of individual writing process has recently captured researchers' renewed attention in research on L2 writing and TBLT, as it is crucial to understand the underlying cognitive processes for L2 learning (e.g., Révész et al., 2019). Compared with individual writing, the CW processes can be accessed easily in that CW tasks allow learners to verbalize their thoughts, and their interactions at planning, composing, and revising stages can be fully tracked via recordings. In particular, computer-mediated CW seems more advantageous, as technologies (e.g., wikis and Google Docs) afford full access to co-writing processes. For instance, researchers can clearly see the evolvement of jointly-produced texts through Google docs history logs and get a holistic picture of learners' individual contribution to joint texts through Docuviz, an add-on application plugged in Google docs (Wang et al., 2015). Accordingly, assessing CW process will constitute an important inquiry for future research, particularly motived by the new technology affordances. Moreover, the nature of CW tasks will influence how CW products should be assessed. For example, linking to Research task 1 on multimodal CW, researchers need to design a new model (different from monomodal CW) that assesses multiple modes of meaning-making (e.g., images, texts, speech, and videos). Research on assessing multimodal writing is rather scarce (Hafner & Ho, 2020; Hung et al., 2013), let alone multimodal CW, so connecting CW assessment with DMC tasks/genres will greatly add to the current body of literature.

Research task 5:

Develop effective CW assessments that (a) address both the product and process of collaboration and (b) align with corresponding writing genres.

Inquiries of CW assessment are mainly contained in the research on CW products,[2] which predominantly focus on assessing writing products through analytical and holistic rating rubrics (Storch, 2005). Considering the role of assessment in collaborative learning, researchers (e.g., Li, 2018; Storch, 2013) noted a pressing need to create assessment criteria addressing both the CW product and the CW process. As Li (2018) noted, it is necessary for teachers to assign a certain portion of grading points to CW processes reflecting both the equality and mutuality of peer interaction, which would help motivate all group members to actively engage in the CW processes, diminishing social loafing and free riding, and meanwhile avoiding damaging positive interdependence and accountability that assigning individual grades to CW tasks would result in (Pfaff & Huddleston, 2003). Also worth considering is the inclusion of learners' self-assessment and peer-assessment as part of the assessment for CW processes, which may enhance students' task motivation and agency.

Despite the dearth of reported empirical studies in this domain, two ongoing projects deserve mentioning here. Storch and Knoch (in preparation) discussed a rating scheme created to assess both the co-authored product and the process of collaboration in computer-mediated CW. They validated it with a group of ESL instructors who used this rating scheme to assess their students' CW and elicited their perceptions on the new scheme from a focus group interview. Moreover, Zhang and Chen (under review) developed a rubric assessing both the product (in terms of content, organization, and language use) and process of computer-mediated CW (using a five-point scale of mutuality and equality of peer interaction), and then piloted it with trained EFL instructors, followed by interviews with these instructors. Comparing the effects of two assessment approaches (product-based vs. process- and product-based) on learners' interaction and writing performance, they found that the students in

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the new assessment group formed more collaborative relationships and produced significantly longer texts and essays of higher quality. Building upon the two studies, researchers can further probe into the questions on CW assessments: What types of formative assessment of the CW processes can best encourage group members' collective contribution? How do assessment approaches/strategies affect L2 learners' interaction and writing performance? Mixed methods studies would be helpful to address these questions, drawing on triangulated data sources, such as CW processes, writing products, students' viewpoints, and teachers' observation and perception data.

Moreover, CW assessments need to be in alignment with writing genres. As discussed in Section 2.1, multimodal CW can be a genre widely implemented in L2 classrooms in the next decade, so it is important for researchers to explore assessments for multimodal CW. Although no previous research has examined assessments for multimodal CW, studies on assessing the products of multimodal writing (e.g., Hafner & Ho, 2020; Hung et al., 2013) can provide some insights. For example, Hafner and Ho (2020) examined the teachers' perceptions of assessing multimodal composing (i.e., science documentary) after completing assessments using an analytical rubric. Based on the teachers' perceived assessment criteria and challenges, Hafner and Ho (2020) proposed a process-based model to assess DMC across multiple stages (i.e., pre-design, design, sharing, and reflection) involving both formative assessment and summative assessment. Their study enhanced our understanding of assessment rubrics acting as a pedagogical tool to foster students' agency and engage their learning. Due to the notable research gap on multimodal CW assessments, future research will be highly welcome that explores the assessment involving both the product and process of multimodal CW and that delves into the interplay of multimodality, collaboration, and writing outcome.

2.6. Research theme: Pedagogical perspective of CW task implementation

The last research theme focuses on the pedagogical perspective of CW implementation. As previous studies informed us (e.g., Kost, 2011; Li & Zhu, 2013; Storch, 2005; Wang, 2014), students generally express positive attitudes towards CW in either F2F or CMC contexts, as CW affords collaborative co-construction of writing and L2 knowledge. However, a few students' reservations about CW were also detected mainly due to group members' unbalanced contribution and lack of sense of co-ownership (Arnold et al., 2012; Storch, 2005). In order to encourage students' positive attitude and help them smoothly conduct CW tasks, pre-task training on CW is essential, including the modelling of collaboration and the modelling of technology use if applied (Kim & McDonough, 2011; Li, 2018; Storch, 2013). It would be also helpful to train students on how to achieve coherence and cohesion of their collaborative texts. Another factor essential to task implementation is group assignment, including the group size and group composition. In terms of group size, Li (2018) suggested limiting the number of collaborators to four, as a larger group may be associated with a weaker sense of text co-ownership, leading to one or more social loafers and free riders (Kessler & Bikowski, 2010; Piezon & Donaldson, 2005). Regarding group composition, students' target language proficiency levels and L1/cultural backgrounds need to be taken into consideration. Specifically, grouping students with mixed language proficiency may be encouraged as it is more likely to allow peer scaffolding to occur (Ohta, 2000; van Lier, 1996), but it is still possible that pairs of similar language proficiency levels produce much peer scaffolding (Watanabe, 2008; Watanabe & Swain, 2007) while mixed proficiency pairs are engaged in little language negotiation (e.g., Storch & Aldosari, 2013). Due to such mixed findings, future research needs to continue examining the effects of proficiency pairing/grouping on aspects such as patterns of interaction as explored in Watanabe and Swain (2007). Moreover, whether we should group students from different L1/cultural backgrounds deserves further investigation. We may group students from different L1/cultural backgrounds in order for them to communicate in the target language, but students may feel isolated if they do not share the cultural background with other collaborators within the group (e.g., Li & Zhu, 2017a). Group composition thus constitutes a factor that deserves further inquiry, which is expected to provide pedagogical insights on CW. In addition, little research on CW-recruited teachers as participants (Zheng et al., 2021). Research studies

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focusing on teachers' perspectives such as teachers' perceptions of using CW in L2 classrooms will largely add to the current body of literature.

Research task 6:

To facilitate CW task implementation, explore effective grouping and pre-training strategies and invite teachers' input on CW.

Previous studies have examined grouping strategies in terms of group size (e.g., Fernández Dobao, 2012) and group composition, involving language proficiency (e.g., Leeser, 2004; Watanabe & Swain, 2007) and heritage background (i.e., Fernández Dobao, 2020). Fernández Dobao (2012), in addition to comparing CW and individual writing, examined the effect of group size (i.e., four members vs. pairs) on L2 learners' collaborative dialogues and writing products. The results revealed that four-member groups produced more LREs as well as a higher percentage of correctly-resolved LREs than pairs, thus leading to more accurate texts. However, the optimal group size may be subject to change depending on the task nature, task mode, and goal of a task. Thus, future research can extend Fernández Dobao's (2012) study regarding the effect of group size on peer interactions and writing products, using different sample populations and/or adopting different collaboration modes. Follow-up studies could also compare pairs and three-member groups for CW tasks.

Moreover, Leeser (2004) initially drew our attention to the impact of proficiency pairing by examining low-low pairs and high-low pairs in producing LREs, finding more LREs and a relatively higher proportion of correctly-resolved LREs from high-low pairs. Continuing this inquiry, Storch and Aldosari (2013) explored LRE productions in relation to three different proficiency pairing: low-low, high-high, and low-high. The results showed that overall high-high pairs generated the most LREs as well as the highest proportion of correctly-resolved LREs, and the mixed proficiency pairs (i.e., low-high) did not necessarily generate more LREs than the low-low pairs, which can be explained by the relationship formed/patterns of pair interaction. The important role of collaboration patterns was clearly presented in Watanabe and Swain (2007). They found that the core-high pairs (i.e., the pairs with the core participants having the higher proficiency level) produced more LREs than core-low pairs, but the core participants received higher post-task scores when working with partners of low-proficiency levels rather than high-proficiency levels. Importantly, no matter what the proficiency pairing is, pair members achieved higher post-test scores when they engaged in a collaborative pattern of interaction. The importance of patterns of interaction for learning was reinforced in later studies (e.g., Li & Zhu, 2013, 2017b).

Future research can further validate the findings regarding the effect of language proficiency grouping in comparison with the patterns of interaction. One step further would be to investigate the effect of grouping based on L1 or cultural backgrounds. As a starting point, Fernández Dobao (2020) grouped her Spanish learners based on cultural backgrounds, namely heritage learners (HL)-L2 learners, HL-HL, and L2-L2, and reported that both HL and L2 Spanish learners had very positive perceptions of CW within mixed pairs. Future research can continue to explore the effects of such a cultural grouping (involving heritage and L2 learners) on peer interactions and writing products. Moreover, in classrooms where learners are of diverse L1s, their L1/cultural backgrounds need to be taken into consideration when they are grouped for CW tasks. Future research could examine the impact of different grouping (heterogeneous vs. homogeneous in culture) and answer questions such as if (and how) heterogeneous grouping and/or homogeneous grouping facilitate CW. Such a line of inquiry would also involve a well-deserved research area on the use of L1 and L2 in CW (e.g., Antón & DiCamilla, 1999; Zhang, 2018, 2021).

Unlike the relevant field of L2 peer feedback in which the effect of training was elaborated in previous studies (e.g., Liou & Peng, 2009; Min, 2006; Zhu, 1995), little previous research has probed into the effect of student training on CW. Kim and McDonough (2011) examined the effects of pre-task modelling on CW. They found that the EFL learners who viewed videotaped models of collaborative

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interaction produced more LREs and a great portion of correctly-resolved LREs than learners who did not receive pre-task models, and the pre-task modelling also helped learners adopt collaborative patterns of interaction. Chen and Hapgood (2021) recently tackled a similar issue and examined how EFL learners' knowledge about CW affected patterns of interaction and languaging opportunities. The results revealed that the learners receiving explicit CW-related metacognitive knowledge exhibited more collaborative patterns of interaction and generated more LREs than those who did not. The above two studies clearly show the importance of pre-task modelling/training in CW. However, the scoping review of Zhang and Plonsky (2020) shows a huge lack of pre-task training in previous F2F CW research. As to the literature on computer-mediated L2 CW, Zhang et al. (2021) reported wider attention to the training of technology than the training of CW. Considering the importance of training for CW, future research should continue to probe into questions about pre-task training strategies for both F2F and CMC CW: How to enhance L2 learners' knowledge of CW and ability to implement CW through training? How to train L2 learners on using technology tools to conduct CW? How can the training integrate both CW knowledge and technology use so as to facilitate computer-mediated CW?

In addition, teachers' perspective on CW is rather scarce in the current literature (Zheng et al., 2021), which could constitute an important research agenda. Students' perceptions of CW have been largely explored in previous research (e.g., Kost, 2011; Li & Zhu, 2013; Wang, 2014), but the perspectives of teachers, who play a fundamental role in designing and implementing CW tasks, have been barely tackled. The field can benefit from research that thoroughly examines (a) teachers' attitude towards CW in relation to their knowledge and metacognitive knowledge of CW, and (b) challenges presented while implementing CW tasks in various classrooms. Future research could also do needs analysis with teachers of what is needed to successfully implement CW in L2 classrooms. Insights gained from such research have important implications for teacher training. More importantly, recognizing practitioners as important stakeholders and inviting their input are central for this classroom-based domain to continue to progress, which in the long term is to help promote two-way communication between CW researchers and L2 practitioners.

3. Conclusion

As a relatively new direction in L2 writing research, CW boasts robust interest in the past decade. Given that online learning is increasingly prevalent and large classes are not uncommon, CW, especially computer-mediated CW, which can help alleviate student isolation in online learning and in large classes, is foreseen to continue enjoying growing interests from both L2 researchers and practitioners. A research agenda discussing a diverse range of research tasks is definitely timely. In this article, we have addressed CW issues in both F2F and CMC contexts from empirical, methodological, and pedagogical perspectives. We have identified six main research themes on CW that need to be more thoroughly explored: (1) CW tasks, (2) peer interaction, (3) writing products, (4) methodological practice, (5) CW assessment, and (6) CW implementation. After explaining each research theme, we discussed the correspondent research task, which included two or more sub-tasks. These tasks, which are illustrative rather than exhaustive, range from the examination of multimodal CW, development of frameworks for analyzing learner interaction and writing products, to the expansion of research techniques and pedagogical perspectives of CW. Through identifying a broad range of issues on CW meriting future inquiries, this article seeks to move forward this promising area and help frame the exciting trajectory of research on CW in diverse L2 classrooms in the future.

Notes

[1] It should be acknowledged that the word limits imposed on journal articles and book chapters may have presented challenges for a full description of various validity strategies (especially regarding thick descriptions).

[2] An important distinction needs to be made between CW products (i.e., learners' co-constructed texts in CW tasks; Wigglesworth & Storch, 2009) and learners' performance in subsequent individual writing tasks (e.g., Bikowski & Vithanage, 2016; Hsu & Lo, 2018).

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