

**Technology-Enhanced L2 Writing:
A Systematic Literature Review Analysis and Synthesis**

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Abstract: A key challenge of second/foreign language acquisition is writing. Improvements in the capabilities and availability of technology have resulted in increased use of technology in L2 writing instruction. This review and analysis of 50 research studies on the effects of technology on L2 writing covers literature utilizing both quantitative and qualitative research methods. Both collaborative and individual writing are examined, both in terms of achievement and perception. Additionally, the impact of writing task structure is investigated. Results suggest technology generally has a positive effect on both L2 writing achievement and perceptions. The impact of task structure as a moderating factor on L2 writing was found to be inconclusive, and further research to link L2 writing performance to this and other factors is recommended.

Keywords: collaborative writing; foreign language writing; individual writing; L2 writing; task structure; technology; writing achievement; writing perception.

Introduction

The purpose of this analysis is to systematically review qualitative, quantitative, and mixed methods studies that appeared in peer-reviewed journals between 2006 and 2016; it differs from previous reviews in that we focused on technology-enhanced second/foreign language writing, a topic that has been underrepresented. Furthermore, the literature reviews that match ours in scope tend to lack the recentness that is desirable for research literature pertaining to such a rapidly-evolving topic; many new technologies have been developed since those reviews were published.

We are guided by the following research questions:

1. What is the effect of technology use on achievement for collaborative and individual L2 writing?
2. What is the effect of technology use on perception for collaborative and individual L2 writing?
3. What is the effect of task structure (high, medium, and low) on L2 writing achievement and perception?

Methods

Task Structure Definition

In this literature review we focused on the level writing structure, in terms of guidance from instructors/researchers, provided for the L2 learners. Because structure is difficult to define, and not all the studies included explicit discussions of it, the authors of this review cross-checked with each other to ensure consistency in our coding of this construct. The following are the working definitions developed for *High*, *Medium*, and *Low* structure.

High Level of Structure for Writing Activity

High-level structured writing tends to ask students to deliver a product that follows the instructor's guidelines and criteria rigidly, and students' writing is evaluated based on each criterion on a provided rubric. For example, instructors may ask students to write

a composition by assigning a specific topic with detailed requirements and formats. Then, the composition is typically evaluated by several specific criteria (such as the IELTS nine-band scale).

Medium Level of Structure for Writing Activity

Medium structure involves some guidance, while allowing students a degree of freedom with formats, styles, contents, and/or quantities. For instance, to produce a medium-level structured writing product, students are expected to write a discussion post with some requirements for content set by instructors.

Low Level of Structure for Writing Activity

Students are not writing based on specific criteria, nor evaluated according to a rubric. Instead, students are permitted to write freely with a given general topic. For example, low level structure can be related to any type of Facebook post, dialogue journal, or general reflection of a general topic.

Inclusion and Exclusion Criteria and Search Strategy

We limited the studies included in this literature review to those published in peer reviewed journals between 2006 and 2016 which focused on the use of technology in second language acquisition. Using terms such as collaborative writing, second language, and technology, we searched our university library's databases for empirical studies meeting our inclusion criteria, contained within 21 different journals.

Results

Through our search of peer-reviewed journals we were able to identify 50 studies, quantitative, qualitative, and mixed methods, that met our inclusion criteria. Unsurprisingly, the journals that published the most studies meeting our criteria were *Computer Assisted Language Learning* (12), *Language Learning and Technology* (9), and the *CALICO* (Computer Assisted Language Instruction Consortium) *Journal* (7). Most of the

other eighteen journals published only one or two studies meeting our inclusion criteria.

L2 Writing and Achievement

L2 Collaborative Writing and Achievement

Findings based on qualitative data suggest reasons and the means through which technology positively impacts collaborative writing. Blin and Appel (2011), who examined various collaborative writing technologies, found the online presence of students' texts influenced and mediated the students' activities. Kessler, Bikowski, and Boggs (2012) found that online collaborative writing technologies were flexible tools that enabled students to collectively edit their texts as they worked. Strobl (2014) found that writing with Google Docs promoted discussion among participants that deepened their understandings. Their findings also supported the body of evidence suggesting that technology-enhanced collaborative writing "stimulates recursive writing" (p. 13) and improves "content selection and organization" (p. 12).

L2 Individual Writing and Achievement

The qualitative findings of most of the studies focusing on individual writing indicated that technology-enhanced writing experiences improved the L2 writing abilities of the learners. Bloch (2007) found that blogging helped improve the participating students' ability with rhetorical strategies. Likewise, through blogging the participant in Gebhard, Shin, and Seger (2011) improved her ability to write for wider audiences in academic and personal registers. Ducate and Lomicka (2008) traced the participants' evolution as L2 bloggers through eight distinct stages that begin with reading native-speakers' blogs. These experiences brought them into contact with the target culture and enabled them to express themselves creatively. They enjoyed their blogging experiences and appreciated that they could experiment with language and take control of their learning. Yeh (2015), who also traced L2 writer development, found the participants went through "four metacognitive stages of applying genre knowledge" (p.

488). Collaborative writing experiences heightened their linguistic awareness and helped them improve their knowledge of, and competence with, the targeted academic genres. Shin and Cimasko (2008), who explored L2 learners' use of various media in the construction of personal web pages, found the participants focused many of their efforts on written media. They used visual media to support their written texts and express their emotions, cultures, and personal identities. Through the examination of the learners' texts, Zhang (2009) discovered that students developed a sense of community through writing on a bulletin board.

L2 Writing and Perception

L2 Collaborative Writing and Perception

Qualitative study findings focusing on the use of technology in collaborative L2 writing indicated that participants had positive perceptions of group writing experiences, recognizing the benefits of using these technologies. Most participants in Chao and Lo (2009), Lee (2010a), and Wang (2015) indicated they had positive views of their collaborative writing experiences. The students in Lee (2010a) were particularly satisfied with writing assignments that were interesting, authentic, and related to their coursework, yet offered some freedom regarding topic choice. The results of Wang (2015) pointed out specific areas of student satisfaction, including affordances for interaction, feedback from peers, development of collaboration and communication skills, and increased confidence in writing in the targeted genre. Some of the participants in Martinsen and Miller (2012) were somewhat less enthusiastic regarding the use of wikis for collaborative writing, with the research results indicating they "would [only] somewhat prefer to use a wiki for a future collaborative assignment" (p. 80). However, they did appreciate that wikis enabled them to write collaboratively and co-construct knowledge. Li and Zhu (2013) found perceptions of collaborative writing experiences were influenced by intra-group dynamics and interactions.

L2 Individual Writing and Perception

The majority of the findings in qualitative studies focusing on participants' perceptions of technology-enhanced individual writing indicated the students generally had positive perceptions of their experiences and valued using technology. Grami (2012) found students valued blogging as social and learning exercises, and they also positively perceived peer feedback. The results of a survey in Lee (2010b) suggested that students positively viewed all the blogging exercises they performed, as well as feedback from their instructor and peers. In Zhang, Song, Shen, and Huang (2014), peer feedback was also seen as a major strength of blogging. Many participants in Chen and Brown (2012) similarly found blogging interesting, and thought viewing peers' blogs created "friendly competition" (p. 447), which motivated them to write more content with increased creativity. The majority of the students in Ducate and Lomicka (2008) saw academic value in the use of blogs, and indicated they would like to continue blogging in the future. They further felt that reading and writing blogs brought them into contact with the target culture and enabled them to co-create knowledge with their peers. Most of the participants in Featro and DiGregorio (2016), a large-scale survey of foreign language instructors, indicated they highly valued the use of blogs in L2 writing education. They also indicated many ways they desired or planned to employ blogs in future courses (e.g., as electronic portfolios or discussion forums). Many of the participants in Noytim (2010) appreciated that blogs develop ability with self-expression, learner autonomy, and "analytical and critical thinking skills" (p. 1128). Finding blogging interesting, many of them also believed it increased their confidence and motivation to write in the L2. Some of the participants in Vurdien (2011) pointed to the value of blogs in enabling learning to occur outside of classrooms.

While blogs were the technological focus of many studies on individual writing, some researchers explored other technologies. Many students in Wong, Chai, and Gao (2011) noted that effectively using a tool for inputting Chinese characters is dependent upon the user's linguistic knowledge, technical skills, and ability to infer the pronunciation of

characters from context. The results of Mahfouz (2010) indicate that regular email exchanges with native speakers were perceived by many students as a means of improving the quality of their L2 writing.

Task Structure, Achievement, and Perception

We examined fifty studies to determine how much structure/guidance was provided to the participants regarding the formats, structure, and/or contents of their L2 writing compositions. We rated 19 studies as *high* in structure, 16 as *medium*, and ten as *low*, while two others did not provide enough description of the writing tasks to rate structure (Li, 2006; Wong et al., 2011). Data in the three remaining studies (Featro & DiGregorio, 2016; Hubert & Bonzo, 2010; Mahfouz, 2010) were obtained from surveys and no actual writing was performed, and are consequently not included in this section.

Achievement

The results of the majority of the studies involving *high task structure* suggest that technology helped learners improve L2 writing ability. Alwi, Adams, and Newton (2012) found that high task structure and language support helped learners focus more on the meanings of their texts, whereas results from Blin and Appel (2011) suggest that learner-created texts, which students collectively created and shared via Google Docs, helped learners coordinate and negotiate their activities. Diez-Bedmar and Perez-Paredes (2012) noted that cooperation levels varied among L1 and L2 collaborative dyads, although collaborative writing was shown by Strobl (2014) to improve student content selection and organization when asked to synthesize and integrate information from multiple sources. Results of Pham and Usaha (2015) suggest that training in how to provide peer feedback on blogs had more positive effect with global rather than local revisions, and found the majority of revisions to blogs were made independent of suggestions from peers. Gebhard et al. (2011) observed that the expanded sense of audience promoted by blog writing helped to expand meaning-making potential. Shin and Cimasko (2008), who explored multimodal writing, discovered L2 writers largely

preferred written text to other (visual) modes to express meaning. While the L2 learners primarily used visuals to support their written text, they were used to express their cultures and cultural identities as well. Xing, Wang, and Spencer (2008) noticed that a researcher-developed e-learning environment helped L1 Chinese speakers adjust their rhetorical writing styles to those of native English speakers. Yeh's (2015) results suggest an online writing system (WRITeam) helped improve the appropriateness of the students' language, as well as knowledge of the genres they wrote. Elola and Oskoz (2010), who compared the use of synchronous chat and wikis in collaborative writing, found different types of technology appeared to influence L2 writing in different ways. For example, the use of synchronous chat tended to correlate with revisions related to meaning, whereas wikis were more frequently used to negotiate ideas discussed in chat. Yen, Hou, and Chang (2015) observed that role playing activities, conducted with synchronous chat and video conferencing software, enabled students to collaboratively construct linguistic knowledge and application.

It should be noted, however, that some of the studies found no statistical evidence of L2 writing achievement in at least some of the examined categories. Albaaly and Higgins (2012), who compared groups of students who learned with and without interactive whiteboards, noticed no statistically significant difference between pre- and post-writing scores for the two groups. Elola and Oskoz (2010) detected no statistical difference between collaboratively and individually written essays with regard to "fluency, accuracy, and syntactic complexity" (p. 57), although the authors noted that the small sample size may have influenced the results.

Students provided *medium task structure* utilizing collaborative writing technologies, such as Google Docs (Suwantarathip & Wichadee, 2014) and wikis (Wang, 2015), scored higher on writing tests than students who did not use these tools. Aydin and Yildiz (2014), who explored the use of wikis, found that students made more meaning-related changes than form-related changes when collaboratively writing informative or

argumentative texts, peer corrections outnumbered self-corrections for argumentative and decision-making texts (although self-corrections were more common in informative texts), and the majority of the corrections the students made were grammatically correct. Kessler, Bikowski, and Boggs (2012) observed that wikis served as flexible collaborative writing tools which enabled students to make corrections as they worked; three different levels of participation were noted, focusing on number of corrections individual group members made to the texts. Li and Zhu (2013) noted three different patterns of interaction within collaborative wiki writing groups: "collectively contributing/mutually supportive, authoritative/responsive, and dominant/withdrawn" (p. 67). Armstrong and Retterer (2008) noted that students generally wrote more words in ungraded blog entries as compared to graded blog entries, while Bloch (2007) found blogging helped a student develop rhetorical writing skills, but not with grammatical accuracy. Chen's (2016) study, in which blogging students were compared to non-blogging students, illustrated that blogging did not help the students develop metalinguistic strategies, but did help them develop metalinguistic awareness. Dippold (2009) observed that students struggled with how to provide feedback on peers' blogs, and that the amount of peer feedback students provided varied from student to student. Ducate and Lomicka (2008) noticed that students went through eight progressive stages when beginning to write blogs in L2. The earlier stages involved reading an L1 writers' blog and then culminated with the L2 students writing their own blogs in the target language.

Crossley and McNamara (2009) found that the texts of students who used language corpora in L2 writing were characterized by expanded and more sophisticated lexical use. Hwang, Chen, Shadiev, Huang, and Chen (2014) observed that students who used mobile phones in a situated learning pedagogical approach wrote better quality texts in terms of rhetoric, functionality, and mechanics. Lee, Cheung, Wong, and Lee. (2013) compared the texts of L2 writers who used a web-based feedback system to those who

did not, and noticed that the former group performed better than the latter in regard to the grammar, structure, and contents of their essays.

The results of the studies with *low writing structure* generally indicated the participants' L2 writing abilities improved as well. However, one noticeable difference between the low structure studies and those with higher levels of structure is that several of the studies in the former group employed relatively simplistic measures of achievement, such as word counts. For example, Fellner and Apple (2006) used word counts as a means to assess whether students made progress in writing with blogs. Garcia and Pena (2011) also included word counts as a measure of achievement in their discussion of learner outcomes. Wang and Vasquez (2014) found that the experimental (Facebook use) group students, wrote more than the control group, but uncovered no statistical evidence that the experimental group's writing quality improved. Zhang (2009), who only provided writing structure in the form of instructor-chosen topics advocated the use of word counts as a measure of achievement, especially for heritage learners. Liou and Peng (2009), who examined the nature of peer feedback on L2 blogs, found that over the course of four blogging assignments, the most common type of peer feedback changed from chatting to those more evaluative in nature, as well as a significant increase in the percentage of "[r]evision-oriented comments" (p. 521) over that time span. The number of accurate revisions resulting from peers' revision comments also rose significantly from the first to fourth blog entry. Shin (2006), who examined synchronous web chat, noted that the interaction patterns of many of the participants involved "helping each other to save face in communication" (p. 71).

Perception

Many of the participants in studies with a *high level of writing structure* indicated that technology-enhanced L2 writing experiences improved their writing abilities (Allen, Crossley, Snow, & McNamara, 2014; Castaneda, 2013; Chao & Lo, 2011; Elola & Oskoz, 2010; Kutlu, 2013), and heightened their motivation (Allen et al., 2014; Kutlu, 2013;

Vurdien, 2011). Many of the specific perceived advantages of using technology to write in L2 included planning (Elola & Oskoz, 2010; Yeh, 2015) and revision (Kutlu, 2013; Yeh, 2015). Peer feedback and a sense of an expanded audience (Castaneda, 2013) were cited as other benefits, particularly in studies involving Web 2.0 technologies such as blogs (Zhang et al., 2014). The participants in studies involving the use of collaborative writing technologies such as wikis (Chao & Lo, 2011; Elola & Oskoz, 2010) or Google Docs (Bikowski & Vithanage, 2016) generally had positive perceptions of these technologies' abilities to enable collaborative learning and writing. Some potential issues of interest were also raised in some of the studies. For example, Zhang et al. (2014) noted that Chinese students were culturally motivated to write quality blog posts in order to "avoid losing face" (p. 678). Elola and Oskoz (2010) found that some students distinguished between the affordances of different technologies. For example, they perceived synchronous chat as an effective means for discussions of ideas and text structure, but not for working on grammatical accuracy. Wikis, however, were generally perceived as an effective collaborative tool for learning how to write in an L2.

In general, most of the participants in the studies with a *medium structure* indicated that blogs were enjoyable (Ducate & Lomicka, 2008), low in stress (Armstrong & Retterer, 2008), or interesting (Chen & Brown, 2012). The students in Chen and Brown (2012) experienced blog writing as interesting and stimulating due, in part, to its stimulation of friendly and motivating competition. Most of the students in Dippold (2009) indicated they thought blogs were useful tools for providing feedback. The majority of participants in Ducate and Lomicka (2008) stated that they enjoyed reading and writing blogs, and that blogs had value for learning how to write in the target language. Most of them felt blogs improved their lexicon and reading skills, but perceptions were lower (yet still positive) regarding the role of blogs in improving their knowledge of popular culture. Chen (2016), however, is one of the few studies in this review that did not find technology-enhanced L2 writing to be a largely positive experience for the participants; blogging and non-blogging students experienced similar levels of writing anxiety and

motivation, while the non-blog class indicated they believed they had achieved higher levels of writing efficacy.

Google Docs and wikis were perceived by many of the studies' participants as an effective means to collaborate (Suwantarathip & Wichadee, 2014; Wang, 2015) and share feedback. The participants in Lee's (2010a) research perceived the positive pedagogical value in collaborative writing activities that were authentic or relevant to course contents, preferring collaborative writing wikis tasks with enough structure to promote learning, but with enough freedom to allow creativity, although some students indicated their lack of confidence with their own language skills, which led them to hesitate correcting their peers' writing. In Houat (2012), the students indicated that the use of wikis helped build a sense of community, increasing their confidence and enabling them to create and share knowledge and new ideas. However, perceptions of collaborative writing technologies were not *overwhelmingly* positive in every study. Participants in Aydin and Yildiz's (2014) research, for example, rated wikis between neutral and positive, while Li and Zhu (2013), who examined group dynamics in wiki-based collaborative writing, found that the learners' perceptions of the interactions within collaborative writing groups correlated with their perceptions of the value of learning how to write with wikis.

Many of the students writing blogs in the studies evaluated as *low in writing structure* valued the feedback they received from peers and/or teachers (Grami, 2012; Lee, 2010b). They also perceived blogs as an effective method for improving their writing abilities (Grami, 2013; Lee, 2010b), increasing their confidence in writing ability (Noytim, 2010), and found that peer feedback increased levels of collaboration, motivation, and satisfaction with their writing exercises (Zhang, 2009). Many of the students in Martinsen and Miller (2012) also perceived wikis as a tool that fostered collaboration. The majority of the participants in Shin (2006) indicated they preferred class-wide internet chats to small group interactions. The participants also cited various

motivations for participating in the web chats, including socialization, and sharing academic and professional information. Many of them also indicated they preferred to enjoy chatting without worrying about using grammatically correct language.

Themes

Motivation, Engagement, and Attitudes

One of the most prevalent themes permeating the qualitative research under review concerns motivation, engagement, and attitudes on the part of the participants. Some researchers found that the use of technology contributed to the motivation of L2 writers: They noted that blogging increased students' interest, motivation, and confidence in writing (Noytim, 2010; Vurdien, 2013). Positive perceptions were also noted by Chao and Lo (2009) in their study of L2 writing with wikis. Not surprisingly, the level of satisfaction and motivation is dependent on the topic and the content; more personal topics are engaging to students, allowing them to express themselves through writing (Ducate & Lomicka, 2008). Higher levels of satisfaction are reported when content is relevant and authentic (Lee, 2010a). Chen and Brown's (2012) study of collaborative writing through blogging found that seeing others' blogs created an atmosphere of friendly competition, thereby increasing motivation. It is important to note, however, that a minority of researchers have not found a significant difference in motivation between bloggers and non-bloggers (Chen, 2016).

Feedback

Another major theme present in research on technology and L2 writing is the importance of feedback in the writing process; although this feedback can come from many sources, peer feedback is mentioned most often. The value of feedback depends on both the subject matter and the collaborative goals, according to Diez-Bedmar & Perez-Paredes (2012). Generally speaking, the attitude toward feedback from peers, in the context of blogs in particular, tends to be positive (Grami, 2012; Lee, 2010b). Blogs are also viewed as a useful tool for giving feedback (Dippold, 2009), and it was noted

that blog-mediated peer feedback led to an enhanced L2 writing experience (Zhang, et al., 2014). However, peer feedback is not without its problems. Students often struggled with providing feedback to each other, resulting in uneven distribution (Dippold, 2009).

Other Themes

Additional themes included quality of writing (i.e., accuracy and correctness, complexity, and organization), modes and patterns of interaction, and autonomous selection of topic. Attention to accuracy and correctness was noted by Castaneda (2013), while Lee (2010a) observed wikis utilize collaborative scaffolding to reorganize content and correct errors. Content selection and organization also tended to be improved with collaboratively-written texts (Strobl, 2014). There is mixed evidence regarding blogging and grammatical accuracy. In terms of syntactic complexity, Armstrong and Retterer (2008) noted that bloggers used more complex sentences than the non-bloggers in their study, while Bloch (2007) found little evidence that blogging helped with grammatical control in L2 writing. Regarding interaction patterns, Kessler, Bikowski, and Boggs (2012) noted that, within a collaborative three-person peer-editing group, participation levels were generally uneven; if this result is generalizable, it has significant implications in the classroom. Within the task of collaborative writing, Blin and Appel (2011) found that three modes of interaction tend to prevail: coordination, cooperation, and reflective communication. Participants' perceptions of the learning experience are profoundly influenced by intergroup patterns of interaction; in their study, Li and Zhu (2013) noted three patterns with three groups: collectively contributing/mutually supportive, authoritative/responsive, and dominant/withdrawn. The ability of students to select their own topic and content for their writing tasks was mentioned by Noytim (2010), who noted that blogging promotes learner autonomy, with commensurate benefits in terms of *ownership* of one's learning process. Critical thinking skills of L2 writers were found to be enhanced by the ability to choose one's own topics to write about (Grami, 2012).

Discussion

Based on our review and analysis, it is evident that the recent literature in the area of the effect of technology in L2 writing covers a broad range of technologies, and utilizes a full range of research designs. Although the emphasis was Web 2.0 technology in a large proportion of studies, a multitude of technology has been studied in conjunction with writing in a second/foreign language. Due to the collaborative strengths of Web 2.0 technology, the studies that utilized these tools tended to be those which were focusing on collaborative L2 writing; of these, blogs were the most prevalent, followed closely by wikis. The studies that focused on individual and self-directed writing used a wider variety of available technologies and technological supports, including Google Docs, learning management systems, and tutorials. It is also clear that researchers have utilized a variety of research designs to perform their investigations, with quantitative, qualitative, and mixed-method studies nearly equally represented. It is worth noting that, in general, the quantitative studies tended to focus on L2 writing achievement, qualitative studies tended to emphasize perception, and studies which combined these two measures tended to utilize a mixed-method approach.

The use of technology generally had a positive effect on L2 writer achievement, although the magnitude of that effect varied widely among the studies under review. In an attempt to determine the reason for this variation, we considered other factors (e.g., age, context, task structure); we were unable to attribute the large variation of effect to any particular moderating factors. It is worth noting, however, that the positive effect of technology was present in both collaborative and self-directed writing, in tasks with high and low levels of structure. This would suggest one of the following three possibilities. *First*, it is conceivable that the effect of technology on L2 writing is independent of either degree of collaboration or level of task structure. In such a case, one would argue that neither degree of collaboration nor task structure has any influence on the effect of technology on L2 writing. *Second*, there may be characteristics of collaborative and individual L2 writing that each contribute to the effectiveness of

technology use, but that *offset each other in the aggregate*, leading to the results we found. For example, a high task structure may allow technology to have a beneficial effect due to increased confidence in task parameters, while a low task structure may allow a beneficial effect due to increased learner autonomy. In this case, future research should focus on these individual properties relating to collaboration and task structure in order to discern more specific effects. *Third*, there may be interaction effects among task characteristics and group dynamics that were not taken into account. This possibility could be tested through specific statistical analysis designed to uncover these interaction effects.

Although we did not find evidence indicating a moderating effect of task structure on technology-enhanced L2 writing, it would be premature to suggest that task structure plays no role at all. Two observations support this distinction. The first concerns the importance of feedback as a recurring theme in the qualitative research studies under review. Dippold (2009) found that students struggled with how to provide feedback on peers' blogs. This dilemma resulted in variation in the amount of feedback provided among students. While there could be alternative explanations for this, a possible scenario could link this struggle to insufficient structure in the study's task. A second observation relates to the way in which L2 writing achievement is measured in some low-structure tasks--namely, by word count; this is arguably an overly simplistic (and possibly inaccurate) manner in which to gauge L2 writing quality. It is also worth noting that, while a highly structured task may be less stressful and more enjoyable for students who appreciate structure as a way of boosting confidence in an L2, other students may find a less-structured task preferable due to greater autonomy and latitude in their writing. Thus, the distinction is more dependent on individual differences than on research task design.

L2 writers generally viewed technology use as positive. This was true irrespective of level of task structure, degree of collaboration, or other factors which differentiated the

studies. Results also suggest that, although a low level of task structure can be associated with greater autonomy on the part of L2 writers regarding topic selection and content, it is also sometimes associated with overly simplistic measures of L2 achievement, which may have an impact on the results. The most prevalent themes that emerged from the qualitative studies we reviewed were motivation and feedback, each of which is closely related to the use of technology; in addition to its use being extremely motivating for many language learners, feedback affordances are also provided through both algorithmic capabilities of the technology itself, as well as by the collaborative “community” that exists through Web 2.0 technological tools. Other themes included quality of writing, patterns of interaction among study participants, and degree of autonomy for L2 writers. The issue of autonomy may suggest a link between perception of technology use and level of task structure; greater freedom, on the part of study participants, to select a particular topic of interest could explain some of the positive attitudes toward technology use in L2 writing generally. Although there was no significant difference in perceptions between high- and low-structure task designs, there may be benefits of a high task structure (such as increased confidence due to clear understanding of task) that may offset the autonomy benefit of a lower task structure. There is no clear evidence to suggest this, but it may be worth investigating further in future research studies.

Our review and analysis is subject to some limitations, such as (1) a dearth of quantitative studies suitable for statistical analysis of effect size, which makes it difficult to explain wide variations and determine the role of moderating factors, (2) the wide variety of studies characterized by a large number of differing features, creating difficulty in making comparisons and drawing specific conclusions, (3) the difficulty in reconciling analyses of quantitative and qualitative studies in a coherent manner (although the mix adds a depth and richness to our review), and (4) the overrepresentation of university-age students in just a few countries (and underrepresentation of K-12 participants).

Classroom implications include (1) necessity of alignment with educational and pedagogical goals and objectives, without which technology use may be ineffective or inefficient, (2) importance of educators' awareness of L2 writers' cultural backgrounds and academic environment when integrating technology use in the classroom, and (3) attention to instructor training in the use of technologies used in the classroom.

Future research directions mirror some of the limitations previously described, including the need for more quantitative and qualitative studies (allowing for separate analyses), separate features (demographic, as well as task) viewed individually in order to determine moderating factors which may influence the effect of technology on L2 writing, and expansion of research to include younger age groups, as well as more varied educational and linguistic contexts.

Overall, the evidence from a wide range of studies, both quantitative and qualitative, seems to suggest that technology is beneficial for L2 writing, whether collaborative or individual. Further, findings relating to task structure are inconclusive insofar as its impact on second and foreign language writing is concerned; this gives a clue as to possible future research directions. Although questions still remain related to the role of technology in L2 writing, many implications can nonetheless be extracted from the current research and implemented in the language classroom for the benefit of L2 writers. Finally, it is important to remember that technology is a tool, not a substitute for good teaching (Albaaly & Higgins, 2012).

Conclusion

In conclusion, we examined quantitative, qualitative, and mixed-methods peer-reviewed studies, which were published in the past ten years, that focused on technology-enhanced L2 writing education. Recognizing the wide scope of our project, we developed three main guiding questions, each containing sub-parts. The first two explored the effects of technology on achievement and perceptions for both individual

and collaborative writing. The third examined the interaction of levels of writing task structure with achievement and perception. The findings in these studies generally suggest that technology supports improvement of L2 writing abilities; this result generally applies to both collaborative and individual, self-directed writing activities. Findings also indicate that the participants, for the most part, positively perceived the use of these technologies; again, this is applicable to both individual and collaborative L2 writing.

In addition to categorizing studies by type of writing (collaborative vs. individual) and outcome (achievement vs. perception), we classified each study by level of task structure (high, medium, or low). We were unable to find any evidence that degree of task structure had any impact on either perception or achievement in L2 writing with the use of technology. Nor could we find any moderating factors which could be shown to have any effect on technology-enhanced L2 writing achievement or perception. Future research may be able to shed some light on these issues.

Although there were limitations associated with this review and analysis, it provides a foundation of qualitative and quantitative results which, with specificity of focus, diversity of context, and further investigation, can lead to a more thorough understanding of the role of technology in L2 writing.

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