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Technology-Enhanced Writing Pedagogy for EFL Learners:
A Multi-Study Dissertation on Practice, Effectiveness, and Teacher Perceptions

DISSERTATION

submitted in partial satisfaction of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

in Education

by

Xiao Lin

Dissertation Committee:
Professor Penelope Collins, Chair
Professor Michael Hebert
Professor Mark Warschauer

DEDICATION

To my parents who gave me life and strength,
to my friends who are always by my side,
and specially to Harry and Shawn,
who chose me to be your mom.

“Therefore, since we are surrounded by such a great cloud of witnesses,
let us throw off every encumbrance and the sin that so easily entangles,
and let us run with endurance the race set out for us.”

— **Hebrews 12:1**

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FIELD OF STUDY

Technology-enhanced EFL writing and digital literacies; L2 writing pedagogy; mixed-methods research (experiment, meta-analysis, qualitative inquiry).

ABSTRACT OF THE DISSERTATION

Technology-Enhanced Writing Pedagogy for EFL Learners:
A Multi-Study Dissertation on Practice, Effectiveness, and Teacher Perceptions

by

Xiao Lin

Doctor of Philosophy in Education

University of California, Irvine, 2025

Professor Penelope Collins, Chair

English academic writing is a critical yet challenging skill for learners in English as a Foreign Language (EFL) contexts. The rapid integration of digital tools, accelerated by the COVID-19 pandemic, has transformed writing instruction; however, evidence of its pedagogical effectiveness remains fragmented and often overlooks teacher perceptions and genre-specific impacts. This three-study dissertation addresses these gaps by investigating the role of digital tools in EFL writing instruction within the EFL higher education context, employing a multi-method approach to triangulate evidence from student outcomes, meta-analytic synthesis, and teacher experiences.

Study 1 conducted a classroom experiment with 111 Chinese undergraduates, comparing infographic-based pre-writing to traditional outlining. Results showed that infographic creation significantly improved summary-writing quality, source use, and self-efficacy, but not opinion writing, highlighting the genre-sensitive nature of tool effectiveness.

Study 2 synthesized 17 experimental and quasi-experimental studies ($N = 1,085$) through a meta-analysis. It found a statistically significant, moderate overall effect favoring web-based collaborative writing (WBCW) over non-technological collaboration on writing quality

(Hedges' $g^* = 0.51$). Moderator analyses indicated that training was a significant factor enhancing outcomes.

Study 3 explored the perceptions of seven Chinese university writing instructors through qualitative interviews. Grounded in the TPACK framework, the findings revealed that while digital tools are deeply embedded in instruction, their use is shaped by teachers' knowledge, institutional support, and access. Teachers exhibited cautious and limited integration of emerging Generative Artificial Intelligence (GenAI) tools due to concerns over academic integrity and a lack of institutional guidance.

Collectively, the findings demonstrate that technology enhances EFL academic writing most effectively when tools are aligned with genre demands, collaboration is scaffolded by design and training, and implementation is supported by teacher knowledge and institutional context. The dissertation concludes by advocating for a situated, tool-genre-task alignment perspective in future research and practice, moving beyond technocentric adoption to support equitable and effective writing instruction in diverse EFL settings.

Keywords: technology-enhanced language learning, EFL academic writing, infographics, web-based collaborative writing, teacher perceptions, TPACK, genre sensitivity, meta-analysis, China

CHAPTER 1 Introduction

Background

In recent decades, English academic writing has become a foundational skill for participation in global academic and professional communities (Lee & Schmidgall, 2020). For learners in English as a Foreign Language (EFL) contexts, however, the acquisition of academic writing proficiency remains an enduring challenge. Learners often struggle with limited exposure to authentic English input, limited models of academic discourse, and complex demands to align linguistic accuracy with rhetorical structure (Hyland, 2016; Ruegg, 2015). These challenges are shared across diverse EFL settings, making the effective teaching of writing a global pedagogical concern (Leki, 2007).

Amid these challenges, China stands out as a uniquely significant context. With over 400 million English learners and sustained national investment in internationalization (Bolton & Graddol, 2012), English writing instruction in Chinese universities is increasingly seen as a gateway to academic success, graduate study, and professional advancement (Wei & Su, 2012). The pressure to cultivate academic writing competence intersects with exam-oriented curricula, a lack of genre-specific instruction, and uneven access to technology across institutions (Wang & Curdt-Christiansen, 2019; Guo, 2021). Yet, similar dynamics can be observed in other rapidly developing EFL education systems, suggesting a need to explore both global patterns and context-specific responses to the evolving writing landscape.

Concurrently, the emergence of digital tools, ranging from graphic organizers and collaborative writing platforms to automated writing evaluation and AI-based feedback, has transformed the ways in which writing is taught, practiced, and assessed in EFL and second language (L2) settings worldwide (Godwin-Jones, 2018; Elola & Oskoz, 2017). In higher education, writing instruction increasingly incorporates multimodal composition, cloud-based revision, and asynchronous peer interaction, reflecting broader shifts toward digital literacy and

learner autonomy (Kessler & Bikowski, 2010; Kern & Warschauer, 2000). These developments are situated within sociocultural views of writing as a socially mediated and tool-supported process (Vygotsky, 1978; Storch, 2013; Flower & Hayes, 1981).

The COVID-19 pandemic dramatically accelerated these digital transitions. Around the world, instructors were required to shift to online instruction with little preparation, bringing digital writing tools to the forefront of instructional practice (Barrot, 2021). In China, universities rapidly adopted platforms such as Tencent Docs, QQ, and university-wide LMSs to support writing instruction at scale (Bao, 2020; Swanson & Valdois, 2022). Teachers were tasked with revising the curriculum, designing asynchronous peer review processes, and managing student engagement across digital environments. Globally, concerns also emerged about AI-generated writing, academic integrity, and equitable access to feedback technologies (Chen et. al, 2025; Yang et al., 2024). Students were expected not only to write effectively in English but to do so within rapidly changing technological ecosystems that demanded new digital literacies and collaborative competencies.

Despite the proliferation of digital tools and the intensified demand for online instruction, research on their pedagogical impact remains fragmented. While studies have explored the use of tools such as Google Docs, Peerceptiv, or Pigaiwang in isolated settings, relatively few have examined their genre sensitivity, instructional integration, or long-term effects on writing development (Boillos & Idoiaga, 2025; Chen et al., 2025; Yin et al., 2023). Moreover, most empirical work has been concentrated in Western or resource-rich contexts, raising questions about its relevance to underrepresented educational systems where teacher agency, infrastructure, and assessment culture differ (Wang & Curdt-Christiansen, 2019; Lee & Lee, 2023). A broader and more inclusive understanding of writing technology is urgently needed, which incorporates multiple perspectives and instructional layers.

Theoretical Framework

Technology has intertwined with the development of education and played a significant role, especially with the application and adaptation of the World-Wide Web and internet networking (Syafi'i, 2020). Looking at ways in which the tools, techniques, and applications of technology can support learning, Bruce and Levin (1997) believe that technology engages students in exploring, thinking, reading, writing, researching, problem-solving, and experiencing the world. The robust development of information and communication technology (ICT) has made Technology-Enhanced Learning and Teaching (TELL) a new trend in learning writing (Coniam, 2008). Accordingly, the paradigm of learning and teaching writing in English in higher education classrooms around the world has also shifted from the traditional face-to-face setting to the technology-support online or hybrid settings (Jeong, 2015). With the application and penetration of smart technologies and smart devices in the recent decade, more sophisticated modes, such as e-learning or m-learning, have become possible in writing and writing instruction (Jeong, 2016). As a result, web-based means of learning and teaching writing have continued the evolution and have been increasingly integrated into writing practice and instruction.

Technology affects both the writing product and the writing process. It enables students to deal with writing assignments more easily at different stages. For planning in the pre-writing stage, a graphic organizer can help students who may not have clear ideas of a topic or a logical structure to organize the ideas display depicting relationships between ideas within a topic (Evmenova & Regan, 2019). Word processing tools are applied in the drafting process, which facilitates the transition from ideas to well-constructed sentences and organized paragraphs. Technology of word processing also supports writing fluency, especially when compared to handwriting rates (Hetzroni & Shrieber, 2004; MacArthur, 2009). When students revise the draft through editing and proofreading, they can use technology to assist in

self-regulation (Graham et al., 2005, Harris et al., 2008) and peer feedback or peer editing (Dastjerdi, 2016) for correcting, clarification and elaboration.

This dissertation addressed these gaps by investigating the role of digital tools in EFL writing instruction through a multi-study approach. It brought together a classroom-based experiment in China, a meta-analysis of web-based collaborative writing (WBCW) studies in the EFL context, and a qualitative inquiry into the perceptions of Chinese EFL instructors. Collectively, these studies examined how digital tools impacted writing outcomes, pedagogical choices, and instructional design across various educational environments. Rather than treating technology as a static variable, the dissertation examined how it functioned as a dynamic pedagogical resource—shaped by genre, task structure, institutional support, and teacher cognition.

Overview of the Three Studies

This dissertation investigated how digital tools shape EFL academic writing through three complementary studies: a classroom experiment on infographic-supported planning, a meta-analysis of web-based collaborative writing (WBCW), and a qualitative inquiry into the technology integration practices of Chinese university instructors.

Study 1 was a classroom experiment that compared infographic-based pre-writing to traditional outlining in two genres—a source-based summary and a short opinion paragraph—examining writing quality, source use, and self-efficacy. A total of 111 EFL Chinese college students participated in the experiment. Students in the treatment sections created infographics based on a common reading before drafting, while the control group prepared a reverse outline of the same text. The study took place in a regular College English course with intact classes taught by the same instructor. It worked to address the following research questions: 1) Did infographic-based planning, compared with outlining, improve rubric-based writing quality in summary and opinion tasks?; 2) Did it lead students to incorporate source

information more effectively in their written work?; and 3) Did it influence writing self-efficacy related to the demands of the task?

As digital literacies included image and screen literacies, infographics were used not only to communicate but also to plan writing by turning complex readings into structured visual representations that guided drafting (Brown, 2001; Krishnan et al., 2021; Maamuujav et al., 2019). Classroom studies reported gains in organization, clarity, and motivation when learners used infographics and other visual organizers (Nhan & Yen, 2021; Darrington & Dousay, 2015; Alrwele, 2017). However, much of this work was theoretical or focused on perceptions rather than outcomes (Maamuujav et al., 2019; Hameed & Jabeen, 2022; Nhan & Yen, 2021). Few experimental studies in EFL contexts tested whether infographic-based planning improved writing quality for specific genres or examined downstream effects on source use and task-specific writing self-efficacy. This experiment aimed to bridge those gaps by quantitatively analyzing the effect of infographic planning against outlining.

Guided by the writing process theory (Flower & Hayes, 1981), this study positioned the infographic as a planning tool that enabled EFL writers to check their understanding and build macro-structure before drafting. Its multimodal form allowed meaning to be represented with words and graphics, which eased working-memory and other cognitive loads during composition (Lamb et al., 2014; Lazard & Atkinson, 2015). Specifically, infographics were significant because they turned complex reading into clear, visual structures that made key ideas, hierarchies, and connections visible before drafting (Lamb et al., 2014; Lazard & Atkinson, 2015; Smiciklas, 2012). This affordance suggested particular value for genres that demanded accurate selection and structured presentation of source information, such as summary writing (Bruce, 2008). Because perceived control over planning boosted performance (Bandura, 1997; Sanders-Reio et al., 2014), the study also predicted gains in writing self-efficacy when planning through infographics clarified content coverage and elaboration.

Study 2 was a meta-analysis that compared web-based collaborative writing (WBCW) with non-technological collaborative writing for EFL undergraduates, focusing on writing performance and the conditions that shaped effects. Seventeen studies were included in the analysis and contributed 38 effect sizes with a combined sample of 1,085 students. The analysis focused on the following two questions: 1) Do web-based technology applications in collaborative writing improve college EFL students' writing performance compared to non-technological collaborative writing?; and 2) To what extent do substantive factors (e.g., genre, intervention duration, training) and technological factors (e.g., group size, time setting, place setting) moderate the effects of web-based collaborative writing?

Research in collaborative writing was grounded in sociocultural perspectives (Vygotsky, 1978; Storch, 2013). These theories emphasized learning and writing through social interaction, peer scaffolding, and co-regulation, which web-based tools can amplify by enabling real-time negotiation and traceable revision (Donato, 1994; Elabdali, 2021). In the WBCW context, collaboration was mediated by online platforms that supported synchronous or asynchronous co-editing, version tracking, commenting, and peer feedback (Yim & Warschauer, 2017; Li, 2018; Li & Zhu, 2013; Sun & Chang, 2012). Empirical reports with adult EFL learners indicate that web-based platforms facilitate co-authorship, transparent peer editing, and iterative drafting, resulting in improvements in text quality, engagement, and autonomy when paired with appropriate task design and teacher scaffolding (Liu & Lan, 2016; Bikowski & Vithanage, 2016; Strobl, 2014).

However, few syntheses isolated the added value of web-based collaborative writing over non-technological collaborative writing in college EFL contexts. Prior reviews often pooled collaboration with individual writing or mixed technology types while rarely testing moderators such as genre, training, group size, and time/place settings (Xu et al., 2018; Al-Wasy, 2020; Lv, Ren, & Xie, 2021). In recent years, the number of WBCW studies has grown (Cahyono et al., 2023; Lee et al., 2024), particularly after the COVID-19 period, making a focused synthesis both

timely and feasible. This meta-analysis, therefore, aimed to estimate the effect of WBCW on writing quality by isolating it from non-technological collaborative writing and by examining overall and moderator effects in college EFL settings.

Study 3 was a qualitative inquiry with seven Chinese university EFL writing instructors, documenting how digital tools were used in writing instruction during and after the pandemic, the changes in practices, and how teachers anticipated future hybrid and AI-supported arrangements. The study focused on three areas: current classroom uses of platforms that support feedback and collaboration, shifts in perceptions following emergency remote teaching, and views about future hybrid modes and AI in writing pedagogy. These questions were grounded in instructors' reports of tool access, policy constraints, and student engagement in Chinese university contexts.

The work was guided by theoretical frameworks of Mishra & Koehler's (2006) Technological Pedagogical Content Knowledge (TPACK) and Shulman's (2006) Pedagogical Content Knowledge (PCK). In this study, TPACK was presented as the intersection of content, pedagogy, and technology for meaningful integration, and PCK was defined as teachers' knowledge of how students learn specific writing content and how teacher–student interaction is supported online. These lenses justified examining when and how instructors embedded writing-related technologies, pedagogical means, instructional platforms, and AI tools in the service of improving EFL students' writing and writing instruction.

Prior work in this area emphasized tool effects and student outcomes rather than teachers' perceptions and classroom enactment (Chai et al., 2013; Cheung & Jang, 2020; Sariçoban et al., 2019). Moreover, post-pandemic normalization of hybrid learning, along with increased access to new tools such as LLM and AI, necessitated the observation of locally grounded practices and support (Zhang et al., 2024; Zhou, 2024). Accordingly, this study examined how EFL instructors integrated digital tools and platforms in ways aligned with TPACK

and PCK, and considered implications for program guidance and responsible policy in the college EFL writing context.

The dissertation's three studies converge on a simple, transferable idea: technology supports EFL academic writing when its affordances are matched to genre demands, when collaboration makes revision work visible and consequential, and when local conditions allow instructors to enact that alignment. Visual planning with infographics enhances source-based summary writing; web-based collaboration improves global quality and accuracy across delivery modes; and instructors' decisions, shaped by policy and access, determine whether these gains persist in everyday classrooms. By connecting genre-level effects, collaborative mechanisms, and context-sensitive enactment, the project offers a coherent blueprint for designing equitable, high-impact writing instruction in EFL higher education.

CHAPTER 2 The Effects of Using Infographics to Support EFLs in Academic Writing

Abstract

In the digital learning age, information visualization tools such as infographics are used to help students transform complicated or abstract concepts and ideas into accessible images or graphs. Researchers have found that using infographics in writing preparation scaffolds the ideation process of students from L2 or EFL backgrounds and improves their writing quality. This experimental study investigates the effects of creating infographics and outlining as a preparation tool on the writing performance and writing quality of EFL college students in the academic context. With 111 EFL participants from a Chinese university, the study compares differences between treatment (infographic making) and control (outlining) students' summary and opinion writing on writing quality, source text usage, and self-efficacy. Repeated measures ANCOVA / MANCOVA and regression models reveal that creating infographics promotes gains in EFL students' academic writing quality and in their confidence for summary writing, but not for opinion writing. The students from infographics group also use more information from the sources in summary writing. Findings have implications for the theoretical development of EFL academic writing and instructional design in improving EFL writing pedagogy and practices.

Keywords: infographic, EFL students, academic writing, cognitive constraints, writing genres, writing self-efficacy

Introduction

Academic writing is a complex process in which one needs to synthesize content knowledge and skills of language use based on rhetorical and genre conventions (Scarcella, 2003). For students studying English as a foreign language (EFL), academic writing at the university level remains a challenging and complex task (Alharbi, 2019). When writing in English, students must simultaneously comprehend and process information and sources while presenting their ideas logically and using language effectively (Barkaoui, 2019). In the digital age, literacy encompasses image and screen literacy (Brown 2001) and enables infographics, a data visualization tool, to serve as a planning tool to support EFL undergraduates' thinking and academic writing. Researchers (Krishnan et al., 2021; Maamuujav et al., 2019) have found that using infographics to scaffold ideation and planning during writing preparation helps undergraduates from multilingual backgrounds navigate the challenges they encounter in academic writing.

An infographic (or information graphic) visualizes information and ideas (Krishnan et al., 2021). It is "a collection of images, charts, and minimal text that gives an easy-to-understand overview of a topic (Nediger, 2020, para.10)". Because of their effectiveness in communicating data and information visually, infographics have been a target of study by researchers and a popular pedagogical approach to assist the learning process (Lamb et al., 2014; Lazard & Atkinson, 2015; Smiciklas, 2012).

Although infographics are often communication tools, they can also serve as tools to help students plan their traditional writing assignments (Krishnan et al., 2021; Maamuujav et al., 2019). The multimodal nature of infographics allows writers to use words and graphics to deliver information and express their thoughts (Knoll & Fuzer, 2019; Rose et al., 2006). By doing so, writers may feel more competent in the writing preparation process as they can devote cognitive resources to information collection, processing, and construction, thereby reducing the anxiety created by planning structure and producing text in English at the same time (Kellogg, 1988).

Creating infographics enables EFL students to overcome barriers in communicating in English due to limited proficiency and to present their understanding and ideas using words, images, and graphs (Maamuujav et al., 2019). The visual presentation of information and ideas in infographics enables EFL undergraduates to engage with concepts they might not yet have the English proficiency to communicate. In the 21st Century literacy context, when being used as a planning tool in academic writing, the multimodality of infographics can help EFL students address the cognitive and motivational challenges they encounter in the writing process.

There are a few studies that attempt to investigate the effects of infographic usage in writing in the EFL context. Maamuujav and her colleagues (2019; 2021) propose scaffolding L2 students' academic writing and enriching undergraduate writing courses with infographics as a preparation tool to separate writers' planning or ideation in the prewriting stage from the complex writing task. However, their rationale for incorporating infographics in EFL writing instruction is theoretical, without empirical support. Hameed and Jabeen (2022) quantitatively examine the use of infographics as a writing strategy in EFL contexts. While they find empirical support for the benefits of using infographics for students' perceptions, they do not examine the impact on writing quality and writing performance. Similarly, Nhan and Yen (2021) find that incorporating infographics into EFL writing enhances student motivation, yet they also do not evaluate its effect on writing quality. Although there is suggestive evidence that incorporating infographics in EFL writing instruction may improve student beliefs and motivation, little is known about their impact on students' writing quality and performance.

Conceptual Framework

According to Flower & Hayes (1981), the two primary cognitive processes in writing are ideation and transcription. Ideation is the process where the writer generates ideas by identifying, locating, and evaluating the needed information and its source critically (Warschauer, 2007). In the transcription process, the writer composes written text from the generated ideas (Wanzek et al., 2017). Since "the process of writing is hierarchically organized,"

the ideation process is always “embedded” with transcription (Flower & Hayes, 1981, p. 375). For writers whose native language is not English, the intertwined processes may be more cognitively demanding and stressful because they need to simultaneously think and write in another language. EFL writers may devote more cognitive resources and think more deeply about both processes by disentangling the two processes.

Although many EFL students believe good writing entails producing correct spelling and grammar, writing fluency and quality are strongly related to the ideas and structures they develop from their mental resources (Wanzek et al., 2017). Therefore, the study focuses on EFL undergraduate writers’ cognitive constraints in the ideation process at the prewriting stage. The cognitively demanding process of planning (Bazerman et al., 2017; Lindemann, 2001) is one of the main reasons many students, especially EFLs, struggle in writing. Traditionally, outlining is a common practice to help EFL writers plan (Winiharti, 2017). However, EFL undergraduates experience many challenges creating outlines for writing when using source materials (Flowerdew & Li, 2007; Li & Casanave, 2012; Shi, 2010). They may copy phrases from the source material verbatim without fully comprehending them (Cumming et al., 2018). Because of the heavy language demands in outlining, EFL writers must struggle with expressing the key ideas from the source text and the relations among ideas. To this end, the study explores how creating infographics may help EFL undergraduates be more involved in the planning process by using non-verbal forms to organize and show their ideas.

EFL students, who are novice writers in English, may struggle due to the heavy demands of the ideation process, during which their ideas may get stuck, or the information they want to deliver may be challenging to be composed with coherence (Chamot, 2005, Xu & Qui, 2017). Writing in the academic context is more daunting because it is a source-based task with specific writing goals, which requires comprehension of the sources and the demands of the writing tasks. Without sufficient lexical and rhetorical proficiency or deep comprehension of technical source texts and particular academic genres (Cumming et al., 2018), EFL undergraduates may

be overwhelmed by the language and ideation process in planning the writing assignment. As a multimedia literacy technology, infographics can help EFL writers alleviate cognitive constraints in planning, especially in using sources to write particular genres.

According to Bruce (2008), examples of writing genres are: recounting sequenced events (recount), explaining a process (informative essay), arguing a point of view (argumentative essay), and the latter two are frequently used in academic writing. These writing genres refer to the overall internal organization of a writing piece that realizes a “rhetorical purpose to represent one type of information within discourse” (p. 40). EFL undergraduates are apprehensive about writing academic essays because both informative and argumentative writing requires them to work out what information they can use from the scholarly materials and how to use these sources appropriately during the ideation process. As a result, they may be cognitively overburdened by the unfamiliar language and content due to their limited linguistic resources in a foreign language or a particular academic genre (Cumming et al., 2018). Since data visualization enables learners to make abstract and complicated content clear (Lamb et al., 2014; Lazard & Atkinson, 2015; Smiciklas, 2012), creating infographics may allow EFL writers to check their comprehension of sources by graphically representing what they understand about the main ideas, the structure, and critical information. Moreover, infographics have a variety of formats, providing EFL undergraduates the flexibility to display information and their thoughts for different writing types and purposes. Therefore, creating infographics may facilitate the information organization for particular writing genres in EFL students’ writing preparation, enhance the transcription from source materials and ideas into words and texts, and improve their writing quality. For this reason, this study uses a within-subject design to explore the effects of creating infographics for planning on EFL students’ writing in the two genres common in academic writing, informative writing and argumentative writing.

Academic writing may hold challenges for EFL students not just in the linguistic and cognitive domains, but also in motivation. While planning a composition, writers must process

complex information from sources and be mindful of the assigned writing genre. Those cognitive constraints could cause negative affect, leading to frustration and dissatisfaction and reducing the learner's performance (Kalyuga, 2011). Researchers have proved that self-efficacy contributes to writing performance and writing quality (Bandura, 1997). For EFL students, self-efficacy is a robust contributor to their writing performance (Erkan, 2011; Kırmızı & Kırmızı, 2015; Sanders-Reio et al., 2014). However, they are much less confident in writing than their native English-speaking peers due to their limited proficiency and training in the Western style of reasoning for writing purposes (Mckinley, 2013). EFL undergraduates' negative attitudes toward academic writing result from their low estimation of their writing skills in English (Hashemian & Heidari, 2013). Their low writing self-efficacy contributes to their apprehension about writing and may impede their writing. Thus, supporting EFL students' academic writing may involve strengthening their perceived ability to deal with information and make writing plans before their writing assignments.

Infographics as a planning tool to visualize writers' ideas and selected information may play a role in enhancing EFLs' self-efficacy before and during the writing process. With a graphic representation of their thinking map and information collection, EFL undergraduates may feel more secure accomplishing the writing assignments. Krishnan and her colleagues (2021) find that college students from multilingual backgrounds describe writing academic papers as an intimidating task but creating infographics in preparation made them more confident in researching and shaping the paper.

The Study

Although recognized as a popular visual approach for delivering abstract, complex, and dense messages (Lamb et al., 2014; Smiciklas, 2012; Vanichvasin, 2013), the effects of integrating infographics into writing instructions and practices, especially for EFL students' academic writing performance and writing quality, have rarely been applied and researched. This study tests the efficacy of integrating infographics into writing courses and assignments on

EFL students' academic writing and writing self-efficacy. Three classes of 111 EFL students in a Chinese college (2 treatment classes and 1 control class) read a scientific article. Participants in the control class write reverse outlines of the article, while those in the treatment classes create infographics to represent the information in the article. All participants subsequently use their infographics or outlines to write on-demand informative and argumentative essays in class. The quality of the informative and argumentative essays and the extent to which students use information from the source article is compared for the treatment and control classes. Additionally, the current study survey students' self-efficacy in writing before and after the writing tasks to examine the effects of creating infographics as a prewriting activity.

The current study investigates the following research questions regarding the impact of using infographics on EFL undergraduates' writing performance and self-efficacy:

- 1) To what extent does the use of infographics as a planning tool contribute to EFL students' academic writing in the informative and argumentative genres after controlling for the time they use in preparation?
- 2) To what extent does the use of infographics contribute to the way in which EFL students use sources for informative and argumentative writing?
- 3) How does the use of infographics influence EFL students' self-efficacy in their academic writing?

Method

The study was conducted from April to May 2020, and the participants were 111 sophomores from an independent institution under a top-ranking university in China. They were enrolled through the second batch of applicants according to the enrollment procedure of China's college entrance examination, which means their English language proficiency is at the average level among college students nationwide. College English is one of the basic courses required for Chinese college students. The course is not only for language learning but also for preparing for tests and credential exams.

Participants are from 18 different majors (e.g., mechanical engineering, mechatronics, electrical engineering, computer science, law, energy, logistics, and journalism). Notably, none of them are English majors. Students who registered in one of three concurrent College English 5 classes participate (Class 1: N=39; Class 2: N=35; Class 3: N=37). Although students self-select the class based on their preferences such as the time and venue of the classes, all three classes in this study are taught by the same lecturer.

The 16-week College English classes includes writing instruction for part of the course, typically embedding it in the middle of the course and concluding before the end of the semester. The course is quite exam-oriented: the instructor teaches writing mainly by assigning practice essays to students, training them to follow the standardized frameworks of writing structures and writing styles based on the marking criteria of norm-referenced exams. Because writing accounts for 15-20% of the total score in language tests in China, the primary purpose of writing instruction in this course is to prepare students for the standard tests. With better academic writing skills and quality, students can receive higher scores in the College English Test-4 (CET4), one of the general thresholds for attaining a bachelor's degree required by many universities of China, and the CET6, evidence of advanced proficiency in English and considered the ticket to good jobs with high salaries.

Two of the classes are randomly assigned to the treatment condition (n=72) and one class serves as the control group (n=39). Participants from the three classes have comparable English proficiency based on the midterm English exams that evaluates English listening comprehension, vocabulary, grammar, reading comprehension, and writing (Treatment: $\bar{x}$ = 62.5, SD= 10.80; Control: $\bar{x}$ =63.3, SD = 9.83; $p=0.685$). Thus, despite the self-selection into the classes, the mid-semester English exams suggests that the treatment and control groups have equivalence in their English performance.

Because the experimental manipulation occurred during Weeks 12 to 14 of the semester, participants' writing scores from the course's midterm exam in Week 9 was used as their

baseline writing performance. In the midterm exam, students were given about 30 minutes to write a short (180-word) informative essay, accounting for 15% of their midterm grades.

In Week 12, both groups of students were assigned to read a 680-word academic article on COVID-19, entitled “How long does coronavirus stay on surfaces and can they infect you?” from New Scientist Magazine (Hamzelou, 2020). The article describes how the coronavirus spreads and its persistence based on experimental results, and is written for a general audience without medical, epidemiological or scientific expertise. The article has a Flesch Reading ease score of 58.3, and a Flesch-Kincaid grade level of 8.7. The instructor developed a glossary with Chinese definitions for 21 English terms and phrases from the article to help students comprehend the text. Additionally, participants all had background knowledge of COVID-19 as the pandemic had started several months earlier.

In Week 13, students in the treatment group were assigned two tasks after class. First, students watched two videos on infographics through their online class media resource platform, which was established during the pandemic's remote instruction period. The first video was a 10-minute introduction to infographics, including general information about infographics, the guiding principles of creating an infographic, and how to select appropriate templates. The second video, which was about 8 minutes long, provided an example of how to create an infographic using the online software, Visme. After that, students from the treatment group created infographics presenting the main structure and key information of the COVID article they read as the prewriting activity of writing summaries (using the main structure and key information participants extracted from the source article) and opinion statements (using the key information).

In the same week, students from the control group were asked to present their understanding of the main content by creating reverse outlines of the article. Because they had prior experience with outlining in both in-class instruction and after-class practices, they

received no further instructions or resources for creating an outline/reverse outline. The reverse outline is considered the prewriting activity for the control group.

Although both groups of participants completed prewriting activities (creating infographics or reverse outlines), neither group was informed that these would relate to subsequent assignments. That is because some students might “over-prepare” (e.g., writing the required pieces in advance) due to their particular concerns about the in-class assignments credit and thus affect the study results.

After completing the prewriting activity, students from both treatment and control classes completed two on-demand writing tasks in class in Week 14. First, they wrote a 200-word summary of the source article. Next, they wrote a one-paragraph opinion paper using the information from the source article to answer the question: “Based on the article, what do you think you/your family/ your community / your hometown has done to prevent the spread of coronavirus?” Students in both treatment and control classes were encouraged to use their infographics or outlines, and the original source article as references while they wrote their summaries and opinion papers.

All participants were given 50 minutes to complete both the summary and opinion pieces in class with their laptops and submitted the assignments through the online class platform. Moreover, before students began the assignments and on their completion, they were given links to the pretest and post-test online surveys.

The study combines Yang’s (2014) and Mateos et al.’s (2008) writing quality rubrics to evaluate the two writing assignments. This 4-point rubric is based on five criteria to evaluate the quality of participants’ summary writing and opinion statements. Due to differences in the summary and opinion writing content, two sub-categories for the Content criterion are created (see Table 1). Whereas the Content criterion evaluate participants’ selection of the main ideas from the source text for summary writing, it is adapted to evaluate participants’ information use in the argumentative paragraph (see Table 2).

Table 2.1 The Writing Quality Rubric

Score	Content		Integration	Elaboration	Misinterpretation	Language Use
	Selection of the Main Idea	Presentation of Opinion				
4	Includes the topic and all the main ideas. Contains no irrelevant ideas	Includes a thesis/point of view and supporting ideas	Coherent text: Includes sufficient and adequate coherence and cohesion mechanisms	Paraphrasing and relevant elaboration	Contains no wrong or irrelevant ideas	Uses a wide range of vocabulary and sentence structures effectively Language errors are rare
3	Includes the topic and Includes almost all the main ideas. Contains Some irrelevant ideas	Fails to include a thesis/point of view and includes some supporting details OR Includes a thesis/point of view and has few supporting details	Coherent text: Includes sufficient, although not completely adequate coherence and cohesion mechanisms	Copying, paraphrasing, and includes some relevant elaboration	Contains one wrong or irrelevant idea	Uses a range of vocabulary and sentence structure accurately and appropriately. Makes only minor grammatical errors which do not obscure the overall meaning
2	Includes the topic and Includes more than half of the main ideas Contains many irrelevant ideas	Fails to include a thesis/point of view Includes some supporting details Contains some irrelevant details	List of ideas: Some coherence and cohesion mechanisms	Copying, paraphrasing, and includes few relevant elaborations	Contains some wrong or irrelevant ideas	Uses a range of vocabulary and sentence structures minimally adequate for the task Presents frequent grammatical errors which may obscure the meanings of ideas
1	Fails to include the topic and	Fails to include a thesis/point of view and	List of ideas: Clearly insufficient coherence	Mostly copying and some or no paraphrasing	Contains many wrong ideas	Uses only limited vocabulary and sentence

Score	Content		Integration	Elaboration	Misinterpretation	Language Use
	Selection of the Main Idea	Presentation of Opinion				
0	lacks the main ideas	lacks supporting details. Contains irrelevant ideas.	and cohesion mechanisms			structures repetitively or inappropriately Presents language errors that may largely obscure meanings of ideas
	Has no meaningful information	Has no meaningful information	No coherence and cohesion mechanisms	All copying and no paraphrasing	Has no meaningful ideas at all	Almost no correct use of language

Two independent raters co-coded 60% of the assignments based on the rubric with 84% exact agreement and 95% agreement within 1 point. Differences were resolved through discussion. The remaining assignments were evenly distributed between the two raters. They would yield to discussion and consultation when they were uncertain about the rating on specific items.

The study evaluates the extent to which participants use information drawn from the article in their writing in two ways. For summary writing, using sources is evaluated with the Selection of the Main Idea version of the rubric's Content criterion as it addresses how participants select and present information from the source text. For opinion writing, a new rubric is designed to determine the extent to which participants use information from the sources to support their arguments (see Table 2). Appendix 1 shows examples of participants' essays with high and low scores on the source use of both summary and opinion writing based on the two rubrics.

Table 2.2 *The Rubrics for Source Information Usage in Argumentative Writing*

Score	Information Usage	
	Summary Writing	Opinion Statement
4	Includes the topic and all the main ideas. Contains no irrelevant ideas	Has evidence which is clearly from the source and with explanation or elaboration
3	Includes the topic and includes almost all the main ideas. Contains Some irrelevant ideas	Has evidence which is clearly from the source but without any explanation or opinion
2	Includes the topic and includes more than half of the main ideas. Contains many irrelevant ideas	Has evidence but it's not clear if it's from the source or from the general information
1	Fails to include the topic and lacks the main ideas	Has evidence but it's clearly not from the source
0	Has no meaningful information	Completely irrelevant to the topic or has no opinion at all

Two independent raters co-coded 100% of the assignments based on the rubric with 92% exact agreement and 100% agreement within 1 point. Differences were resolved through discussion.

Because the prewriting activity (creating infographics or reverse outlines) was assigned as homework, all participants self-reported the time spent on creating infographics or reverse outlines. These estimates are used to control for time devoted to writing preparation.

The 5-item survey given at pretest of this experiment gathers background information about students. The survey assesses students' self-efficacy in summary writing (Question 1), their previous experiences in creating infographics or writing reverse outlines (Question 4), and some basic information about students' English language learning and usage (Question 2, 3 and 5). Figure 1 displays the pre-test survey for the treatment group.

1. How confident do you feel in writing a summary of an academic article?

Not confident at all		Extremely Confident		
1	2	3	4	5

2. How often do you write a summary of an English article?

Never	Once a semester	Once a month	Twice a month	Weekly
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3. How often do you write in English?

Never	Once a semester	Once a month	Twice a month	Weekly
-------	-----------------	--------------	---------------	--------

4. Have you ever made an infographic in English before?

Never	Yes
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5. How many English articles do you read every semester except for textbooks?

0	2	4	8	More than 8
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Figure 2.1 Example of Pre-test Survey for the Treatment Group

The post-test is designed to compare whether treatment and control students differ in their writing self-efficacy after preparing for writing in the two different ways. At post-test, a 5-point Likert scale is used to evaluate participants' self-efficacy about the writing assignment (see Figure 2). The scale is adapted from Chen, Gully, and Eden (2001)'s general self-efficacy measurement to align with the current study. Question 2 to 5 ask participants to evaluate their writing self-efficacy in terms of the content ("capture the main idea"), use of elaboration ("present essential details"), integration of information ("well organized"), and language use ("use proper language"). Question 1 and Question 6 ask students to rate their feelings about the general writing quality of the summary and the utility of the planning condition (reverse outlining or infographic making). The last question is about the time the participants spent on the intervention.

1. What do you think about your writing of the summary?

Extremely poor		Extremely good		
1	2	3	4	5

2. How confident do you think your summary capture the main idea of the article?

Not confident at all		Extremely confident		
1	2	3	4	5

3. How confident do you think your summary present essential details in your own way?

Not confident at all		Extremely confident		
1	2	3	4	5

4. How confident do you think your summary is well organized?

Not confident at all		Extremely confident		
1	2	3	4	5

5. How confident do you think your summary uses proper language?

Not confident at all		Extremely confident		
1	2	3	4	5

6. How helpful do you think writing an outline can be to a summery writing?

Not helpful at all		Extremely helpful		
1	2	3	4	5

7. How long does it take to write an outline?
_____ mins

Figure 2.2 Example of Post-test Survey for the Control Group

Results

Research Question 1: To what extent does the use of infographics as a planning tool contribute to EFL students' academic writing in the informative and argumentative genres after controlling for the time they use in preparation?

Participants' performance on the two writing assignments is summarized in Table 3. A repeated measures analysis of covariance (MANCOVA) is calculated to compare the infographic and outlining groups' scores on the content, integration of information, elaboration, presence of misinterpretations, and language use criteria of the rubric for their summary writing, after controlling for their writing scores on the midterm exam. After controlling for their baseline writing performance [$F(5,104) = 3.26, p = 0.009$], students in the infographic group write higher quality summaries than students who prepare for the writing assignments by creating reverse outlines [$F(5,104) = 2.50, p = 0.04$]. A series of Bonferroni-adjusted analyses of covariance

(ANCOVA) tests on each rubric criterion, controlling for baseline writing scores, reveal that the infographic group outperforms the outline group in their use of content from the source [$F(1,108) = 5.25, p = 0.024$], integration, or coherence, of their summaries [$F(1,108) = 6.21, p = 0.014$], and use of elaboration [$F(1,108) = 7.51, p = 0.007$]. Both groups show comparable performance in misinterpretations of the article [$F(1,108) = 0.07, p = 0.79$], and the quality of their language use [$F(1,108) = 3.28, p = 0.072$].

A second MANCOVA and set of ANCOVAs are calculated to compare the infographic and outlining groups' performance in opinion writing. After controlling for their baseline writing performance [$F(5,104) = 1.69, p = 0.14$], there are no significant differences in the overall quality of the two groups' opinion writing [$F(5,104) = 1.10, p = 0.36$]. The similar performance in opinion-writing for the two groups is corroborated by the ANCOVAs, where none of the effects are significant.

Table 3.3 Performance of Summary Writing and Opinions Statement on Specific Aspects and in General

Score	Summary Writing		Opinion Writing	
	Outlining (N=39)	Infographic (N=72)	Outlining (N=39)	Infographic (N=72)
Total Quality	12.77 (2.64)	14.15 (2.22)	15.64 (1.50)	15.61 (1.44)
Content	2.69 (0.86)	3.06 (0.82)	3.15 (0.43)	3.26 (0.41)
Integration	2.21 (0.62)	2.50 (0.63)	1.77 (0.84)	1.92 (0.92)
Elaboration	2.21 (0.92)	2.63 (0.60)	3.95 (0.22)	3.94 (0.23)
Misinterpretation	3.31 (0.73)	3.35 (0.74)	4.00 (0.00)	3.96 (0.20)
Language Use	2.36 (0.87)	2.63 (0.66)	2.77 (0.54)	2.74 (0.53)
Source Usage	2.69 (0.86)	3.06 (0.82)	1.87 (0.89)	2.15 (1.01)

Note. Standard deviations are in parentheses.

Furthermore, three regression models are calculated to predict the differences in the quality of informational summary writing (sum of scores based on the five criteria) between the two groups, including possible covariates. The three models are as follows:

$$\text{Summary}_i = \beta_0 + \beta_1 \text{Treatment}_i + \epsilon_i,$$

$$\text{Summary}_i = \beta_0 + \beta_1 \text{Treatment}_i + \beta_2 \text{Baseline}_i + \epsilon_i,$$

$$\text{Summary}_i = \beta_0 + \beta_1 \text{Treatment}_i + \beta_2 \text{Baseline}_i + \beta_3 \text{Time}_i + \epsilon_i,$$

where the outcome variable is the total scores students gained in writing summary, the covariate is dummy variables for Treatment (0: participants who write reverse outlines before the writing tasks; 1: participants who create infographics), and continuous variables for Baseline (writing scores in the midterm exam) and Time (time that participants report they spend in preparation through outlining or infographic creation). Two students, one from the treatment and one from the control, do not report their preparation time, resulting in missing data in Model 3. For the three equations, β_1 indicates the difference in the quality of summary writing between the outlining group and infographic group.

Table 4 displays the results of the three regression models predicting writing quality. In all three models, the treatment effect is significant ($\beta_1=1.38$, 1.61 , and 1.21 , and $SE=0.47$, 0.46 , and 0.48), indicating that informational summaries written by EFL students who create infographics as preparation for the writing task are better in quality than those pieces written by students in the outlining condition, even after controlling for participants' original writing competence and time spent in preparation.

Table 2.4 Regression Models Predicting Quality of Summary Writing Between the

Two Groups

	Model 1 (N = 111)	Model 2 (N = 111)	Model 3 (N = 109)
Infographic making vs. Outlining	1.38** (0.47)	1.61** (0.46)	1.21* (0.48)
Baseline Writing Scores		0.06** (0.02)	0.05* (0.02)
Time Spent in Writing Preparation (min.)			0.03* (0.01)
Constant	12.77*** (0.38)	9.03*** (1.38)	9.04*** (1.36)

R ²	0.073	0.136	0.180
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Note. Standard errors in parentheses. *p<0.05 ** p<0.01 *** p<0.001

Research Question 2: To what extent does the use of infographics contribute to the way in which EFL students use sources for informative and argumentative writing?

The study investigate the treatment and control groups' use of sources for the informational summary and opinion writing by calculating a repeated-measures ANCOVA with treatment group (infographic vs. outline) as the independent variable, use of sources as the dependent variable, genre (summary vs. opinion) as the repeated measure, and baseline writing as the covariate (see Table 3). After controlling for baseline writing [$F(1,108) = 3.71, p = 0.57$], students in the infographics group use information from the source text to a greater extent than students in the control group [$F(1,108) = 8.89, p = .004$]. Neither the main effect of genre [$F(1,108) = 2.73, p = .10$], nor the interaction between treatment group and genre [$F(1,108) = 0.42, p = .52$], are significant. Thus, the findings suggest that using infographics as a prewriting activity increases EFL students' use of information from the source text. Appendix 1 presents examples of how participants' source use in writing the two genres of essays evaluated.

Research Question 3: How does the use of infographics influence EFL students' self-efficacy in their academic writing?

The last finding corresponding to the 3rd research question indicates that using infographics in writing courses and assignments might have scaffolded EFL students' self-efficacy for academic writing in English. The survey results indicate that after controlling for baseline writing performance, participants who create infographics as a prewriting activity show greater confidence in grasping the main ideas (described in the table as "Content") and delivering essential information (described in the table as "Elaboration") when writing an academic summary than those who develop reverse outlines (shown in Table 5). Students from both groups report comparable self-efficacy in their general feelings about their summary writing

performance (described in the table as “General View”), organizing the writing (described in the table as “Integration”), and using English properly (described in the table as “Language Use”).

Two students, one from the treatment and one from the control, did not submit their survey results, so there were 109 participants, instead of 111, in the evaluation of self-efficacy.

Table 2.5 Differences in Means of Survey Answers between the Control and Treatment

	General View	Content	Elaboration	Integration	Language Use	Contribution
Infographic making vs. Outlining	0.23 (0.16)	0.36** (0.15)	0.28* (0.15)	0.21 (0.16)	0.14 (0.16)	-0.05 (0.20)
Baseline Writing Scores	0.09 (0.07)	0.04 (0.06)	0.04 (0.06)	0.08 (0.06)	0.09 (0.07)	0.09 (0.08)
Constant	1.93* (0.76)	2.57*** (0.72)	2.53*** (0.72)	2.06** (0.73)	1.97* (0.76)	2.47** (0.92)
R-squared	0.032	0.049	0.030	0.029	0.022	0.014
Observations	109	109	109	109	109	109

Note. Standard errors in parentheses. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

Discussion

The current study examines the effects of using infographics as a planning tool on EFL students' performance across two genres, summary writing, and opinion writing. Additionally, it explores how using infographics may influence EFL students' self-efficacy in academic writing.

Overall, infographics as a planning tool is found to be effective in improving EFL students' summary writing, but not for opinion writing. More specifically, writers who create infographics outperform those who write reverse outlines of an academic article, with greater success in identifying, arranging, and presenting the key information from the source text in their summaries. The participants in the treatment class also show greater confidence in the quality of their summaries, complementing past researches that find that multimodal writing assignments can improve students' motivation for writing (Darrington & Dousay, 2015; Utami & Djamdjuri, 2021). Therefore, creating infographics to represent the information may lead to

gains in EFL students' academic writing in the summary genre. The advantages of creating infographics over outlines hold when controlling for the time spent on these activities, suggesting that the benefits of creating infographics to scaffold EFL writing development are not simply the result of greater time on task. These findings add to the growing body of literature finding that infographics can support EFL students' learning academic content knowledge and English grammar (Al Hosni, 2016; Alrwele, 2017)

In addition to the theoretical implications, the study and relevant findings also have practical significance. Students in the treatment classes earn grades in summary writing that are 1.38 points higher than those in the control classroom [C: 12.77/20 (2.64), T:14.15/20 (2.22)], which reflects a 6.9% increase of the writing score and a 1.38% increase of the total score on a scale of 100. One of the main reasons Chinese college students take English courses is to pass College English Test-4 (CET4), which is both a credential of language proficiency for their future studies and career and a prerequisite set by many universities in granting a bachelor's degree. Based on recent data, the pass rate of CET-4 in the year 2019 is about 76% (Zhang, 2020). The National Education Examinations Authority (NEEA) explains that writing accounts for 20%-30% of the total CET score (710 points). Table 6 (NEEA, 2022) provides a recent CET-4 test result showing that a 1.38% increase of the overall score (9.8 points) will drive students who are at the 13th percentile to the 17th percentile. This could change their outcomes on the exam from failing to passing, simply by improving their writing performance. Furthermore, the four categories for measurement of CET writing are linguistic appropriacy, linguistic range and accuracy, discourse organization, and content and idea (Zou, 2022). The effects of using infographics in helping EFL students build academic writing capabilities and self-efficacy, especially in content organization and idea presentation, may enlighten instructors in future writing class design and pedagogical reform.

Table 2.6 *Percentile of Chinese College Students in CET-4*

Score	330	420	425(Pass)	430	510	650+
Percentile	1%	13%		17%	55%	99%

In contrast, creating infographics to summarize a scientific article has no effect on the quality of EFL students' opinion writing. When students developed infographics or reverse outlines, they were unaware that these were in preparation for subsequent writing tasks and believed the purpose was to summarize their understanding of the article. While participants composed the opinion, or argumentative paragraph, which had different writing genres as the informative outlines or infographics, the transfer of information was limited. This may reflect that informational infographics share many of the same elements of traditional summary writing (Matrix & Hodson, 2014). Creating multimodal representations of the scientific article may help EFL students' reading comprehension of challenging texts and strengthen recall and synthesis of textual details (Davis & Quinn, 2014). Constructing the infographics to summarize the article may help students crystalize information and visualize the relations among facts and concepts (Abilock & Williams, 2014). However, because they are developed for the purpose of summarizing the article, the infographics are not organized to visually present a central argument, claims, and supporting evidence. Thus, the infographics are no more effective in supporting opinion writing than traditional outlines.

Recommendation

This experimental study is designed to understand the cognitive and affective constraints EFL writers encounter during the planning and writing process. It provides quantitative evidence on whether creating infographics could help EFL undergraduates with limited English proficiency improve their organization of information and in expressing their opinions in writing. The multimodal elements incorporated in infographics, such as words, charts, images, and graphics, enable EFL writers to be better engaged in the planning and ideation processes than traditional verbal approaches. Moreover, this study extends and complements the field of writing skills and

writing instruction in the L2 and EFL context with experimental results. Multimedia tools, such as infographics, may provide a feasible approach to making the general academic writing training in English more accessible to students from diversified language backgrounds. The multimodality nature of those tools scaffold EFL writing instruction by enabling students to present their thinking and express ideas visually, which allows learners to understand the text and transform the information and knowledge in to words. It reflects universal design for learning (UDL) principles, which promotes the use of multiple modalities and means of expression as means of facilitating learning and instruction to be better aligned with students' needs (Jimenez et al., 2007). The current study supports UDL principles, as EFL students who create infographics as a planning tool are facilitated in understanding the article's content and transforming that understanding into words, and reducing their overall stress about their English proficiency and increasing their sense of efficacy. It may help set a new foundation of EFL writing instruction based on UDL principles, which moves away from traditional learning and practicing strategies of language orientation to the more accommodating ones in the digital age that prioritize ideas and thoughts.

The current findings add to a growing body of research supporting the value of infographics as a pedagogical tool for language learning and writing instruction that ranges from higher-order skills, such as planning traditional essays (Krishnan et al., 2021; Maamuujav et al., 2021), to lower-level skills, such as grammar and word choice (Ushbah & Nurul, 2020). However, the study highlights the importance of aligning the use of digital tools with pedagogical goals (Collins, Tate & Warschauer, 2019), as the benefits of using infographics to scaffolding student writing are limited to when their purposes are aligned with the specific writing genre. That is, incorporating infographics as a planning tool may not serve as a panacea to improve students' writing quality that may be naturally transferred from one genre to another. When designing writing courses and pedagogies, instructors need to align the infographics with corresponding purposes of teaching and learning.

Limitations

One limitation in this study design lies in the randomization of the sample. Randomization was at the class-level, rather than at the student-level, given that it is not feasible to administer different assignments within the same class without cross-condition contamination. However, randomization at the class-level does reduce the power of the design and may reveal differences in the classes rather than conditions. However, the baseline writing scores from the midterm, taken a week before the intervention began, suggests that the English proficiency and writing skills are comparable in the treatment and control conditions and strengthens the trustworthiness of the findings.

A second limitation may reflect the structure of College English 5. In general, all instructors are required to follow a common scope and sequence with the same pacing to ensure students share a common learning experience. The experiment was conducted during the normal instruction period of a general college English course, and only one class hour was available to complete the on-demand writing tasks and surveys. Students prepared the infographics or reverse-organizers at home, and the time spent on these were self-reported. Although students might have inflated the estimated time on the preparation, students in both groups would likely be equally susceptible to provide more desirable estimates of time on task.

The limitations of the study may also affect result that no significant differences are observed when comparing the argumentative essays between the two groups. The writing curriculum and teaching writing in the EFL context have rarely focused on communicating information and expressing ideas proficiently in a foreign language (Javadi-Safa, 2018). The textbook-based or test-oriented instruction may have affected EFL students' writing practices and the study results as well. Argumentative writing is rarely included in their writing course, which makes the tested students unfamiliar with the planning and expression in writing this particular genre. Similarly, EFL students have insufficient training or experience in using source materials to support their argumentation. Participants from both groups in the experiment tend

to use personal experiences rather than the provided scientific article as their source for evidence. Although this may reflect their inexperience in using textual sources as evidence for their opinion paragraph in this study, students have experience using textual sources as evidence for argumentative writing in Chinese, their L1. Thus, it is more likely that the comparable performance for the treatment and control groups in writing opinion paragraphs is a misalignment between the infographics designed to summarize the article and the structure of the argumentative genre.

Another reason that both groups present comparable writing quality in argumentative writing may also lie in the experiment design. Students are required to write opinion statements about pandemic prevention based on the source article. However, they may not be provided with enough details in the prompts to make them fully aware of using source information when they write the argumentative paragraph. The only information in the writing instructions about source use is the phrase “based on the article”. Therefore, both groups might have better performance in terms of using information from the source text if more clear and detailed prompts had been given.

Conclusion

EFL learners are often daunted by the difficulty of expressing their ideas in a foreign language and lacking confidence in conveying academic voice (Alharbi, Mohammed, 2019). The current study suggests that infographics have the promise in serving writing courses and practices in the EFL context as a planning tool to alleviate cognitive and affective constraints that EFL students burden with. The multimodality features of infographics enable EFL undergraduates to transform information and ideas visually rather than verbally during writing preparation and therefore help them overcome language proficiency limitations in the ideation process. For EFL instructors, using infographics can be incorporated as an effective means of writing planning in students’ language courses and training. The enrichment of digital tools in traditional EFL language and writing pedagogy may help both students and teachers from a

non-English background change their minds from language first to ideas prioritized in the academic writing context. Moreover, the benefits of infographics in scaffolding EFL students' ideation process and writing tasks may be bounded to the dimension where infographic making aligns with the specific writing purpose or writing genre. Thus, it is important for EFL writing instructors to adjust their teaching strategies with more attention to higher-order thinking in the preparation process and to effectively use digital supporting tools such as infographics by matching them with the writing tasks and types.

Appendix 1

Evaluation of Source Use of Summary Writing and Argumentative Writing

Summary Writing	Criteria of Source Using (4/4)	Includes the topic and all the main ideas. Contains no irrelevant ideas
	Example of a high score (4/4)	"Many experts told us something about the spread of covid-19. How does covid-19 spread through particles in the air and via contaminated surfaces? How long can the virus survive on surfaces? And what can we do to protect ourselves? The answer to the first question is when an infected person coughs or sneezes, even speaks, the heavier particles will fall to the ground, but smaller, lighter particles can travel further and linger in the air and are more likely to infect other people. And there are many different opinions about the second question, such as 72 hours, nine days and 17 days of survival. But the virus may stay on the subjects for a longer time. The answer to the third question experts told us is that most household cleaning products won't kill coronaviruses. So it is more practical to practice social distancing and good personal hygiene."
	Criteria of Source Using (1/4)	Fails to include the topic and lacks the main ideas
	Example of a low score (1/4)	"Covid-19 can spread via droplets in the air or diarrhea, and it can persist for days on surface. But the virus which persist on surface for days may not

		infect people.”
Opinion Writing	Criteria of Source Using (4/4)	The paragraph has evidence that is clearly from the source and with explanation or elaboration
	Example of a high score (4/4)	“The first thing our community required us to do is to ensure our personal hygiene. In my family, my parents and I washed our hands regularly and open the windows more often. And also, our community asked that we should practice social distancing when we went out to buy things or doing business. People stood 1 meter away from others when they were lining.”
	Criteria of Source Using (1/4)	The paragraph has evidence but it’s clearly not from the source
	Example of a low score (1/4)	“We stay at home nearly 2 months, we can only go out to buy some food twice a week. Everyone who come form other place have to be separated 14 days. The country will pay the treatment cost if you have the coronavirus.”

CHAPTER 3 Writing with Your Peers Face-to-Face or through Technologies:A Meta-Analysis of the Effectiveness of Web-based Collaborative Writing Among EFL College Learners

Abstract

This meta-analysis examines the effects of web-based collaborative writing (WBCW) tools on the writing performance of English as a Foreign Language (EFL) learners in higher education. Seventeen experimental and quasi-experimental studies ($k = 17$, $N = 1,085$) comparing WBCW with non-technological collaborative writing were synthesized. Using a random-effects model and robust variance estimation, the analysis yielded a statistically significant moderate effect (Hedges' $g = 0.51$, $p = .012$), indicating the advantage of WBCW in enhancing writing quality. Moderator analyses explored factors such as training, group size, writing genre, and collaboration conditions (synchronous/asynchronous), with training and group size showing the strongest associations with effect size. Results support the pedagogical value of integrating web-based tools into collaborative writing instruction for EFL learners. Implications for instructional design and future research directions are discussed.

Keywords: web-based collaborative writing, EFL writing instruction, writing performance, educational technology, meta-analysis, peer collaboration, second language writing

Introduction

The increasing demand for effective EFL writing instruction has spurred growing interest in collaborative writing (CW), particularly when mediated through technology. CW, defined as the joint production of a single written text by two or more learners, fosters enhanced attention to language form, content, and audience through co-construction and negotiation (Storch, 2013). The advent of web-based technologies—such as Google Docs, wikis, blogs, and cloud platforms—has expanded the potential of CW, enabling real-time or asynchronous interaction among learners across diverse contexts.

The COVID-19 pandemic further accelerated the integration of web-based platforms in education, prompting a surge of studies exploring how such tools influence collaborative writing processes and outcomes in EFL settings (Barrot, 2021; Zhang et al., 2022). However, most existing meta-analyses in writing research have either focused on comparing collaborative writing to individual writing or examined technology use in isolation from the collaboration process. Few have isolated the specific contribution of web-based technology within collaborative writing tasks. This meta-analysis aims to fill that gap by synthesizing studies that compare collaborative writing with and without digital mediation in post-secondary EFL settings.

Drawing on both cognitive and sociocultural perspectives (Flower & Hayes, 1981; Vygotsky, 1978; Graham, 2018), the study examines whether the Web-based collaborative writing (WBCW) enhances writing performance and what contextual or instructional variables may moderate its effects. Specifically, this review asks whether web-based technology adds measurable value to collaborative writing beyond what is achievable through face-to-face interaction alone.

Literature Review

The increasing demand for effective EFL writing instruction has driven interest in collaborative writing approaches, particularly those mediated through technology. Collaborative writing, defined as a process where two or more learners co-author a single text through

negotiation and shared decision-making, is believed to enhance learners' attention to form, content, and audience (Storch, 2013). In recent years, the rapid development of web-based tools, such as Google Docs, wikis, and blogs, has enabled both synchronous and asynchronous collaboration, making collaborative writing more accessible in diverse educational settings. Notably, the COVID-19 pandemic catalyzed the widespread adoption of online writing platforms, prompting institutions and instructors to integrate digital tools to support interaction and the co-construction of texts during remote learning periods (Barrot, 2021; Zhang et al., 2022). This pedagogical shift has led to an expansion of empirical studies examining the effects of web-based collaborative writing (WBCW), creating an urgent need for a synthesis of findings on its effectiveness in EFL contexts.

Theoretical Perspectives on CW and Peer Interaction

Two dominant theoretical frameworks guide research on collaborative writing: the cognitive process model of writing and sociocultural theories of learning. The Flower and Hayes (1981) model conceptualizes writing as a recursive process involving planning, translating, and reviewing, with writers drawing on their knowledge, goals, and the task environment. Although initially developed in L1 contexts, this model has informed L2 writing research, particularly regarding how writers allocate attention and monitor their output (Storch, 2005).

In contrast, sociocultural perspectives, including Vygotsky's (1978) concept of the Zone of Proximal Development (ZPD), emphasize learning through social interaction. Building on this, Graham's (2018) writer(s)-within-community model proposes that writing is inherently social and shaped by interactions within a community of practice. These frameworks support the view that collaborative writing promotes co-construction of meaning, scaffolding, and internalization of language forms (Donato, 1994; Storch, 2013). In technology-mediated contexts, collaborative tools can amplify these benefits by facilitating real-time negotiation, revision tracking, and written feedback (Elabdali, 2021).

Collaborative Writing in EFL Instruction

Collaborative writing (CW) involves two or more learners jointly composing a single written product through shared planning, drafting, and revision (Storch, 2013). Unlike cooperative writing, CW requires equal participation and co-construction across all stages of the task. Typical stages include brainstorming, outlining, writing, and editing, with students negotiating meaning and making decisions collectively (Bikowski & Vithanage, 2016).

CW is grounded in sociocultural theory, which holds that learners develop language more effectively through social interaction and guided participation with peers (Vygotsky, 1978). During CW, learners engage in peer scaffolding, co-regulation, and dialogue that support linguistic and cognitive development (Lin & Maarof, 2013). Storch (2002) identified four patterns of peer interaction in CW—collective, dominant/dominant, dominant/passive, and expert/novice—based on the levels of equality and mutuality within the group. The collective pattern, which features high levels of both, is associated with better learning outcomes (Fung, 2010).

CW tasks can lead to gains in writing fluency, syntactic complexity, and overall text quality when learners engage equally and meaningfully (Li & Zhu, 2017). In EFL instruction, where learners may lack confidence or input-rich environments, collaborative writing creates opportunities for mutual support, idea negotiation, and shared problem-solving (Lin & Maarof, 2013). These peer interactions not only help develop language awareness and feedback literacy but also foster motivation and accountability (Storch, 2013). By promoting social interaction, reflective learning, and co-construction of meaning, collaborative writing serves as a powerful instructional strategy for both linguistic development and communicative competence (Shehadeh, 2011).

Technology Use in EFL Writing Instruction

Digital technology has become an essential component of EFL writing instruction by supporting students through the stages of planning, drafting, revising, and publishing (Xu et al.,

2019). This integration is informed by the framework of Computer-Assisted Language Learning (CALL), which emphasizes learner autonomy, interactivity, and the use of technology for scaffolded language production (Chapelle, 2001). A range of tools, including word processors, automated feedback systems, learning management systems (LMSs), and online journals, has been adopted to enhance the writing process in both classroom-based and online settings (Zhang et al., 2022).

Word processors enable learners to revise and edit drafts flexibly and are associated with improvements in organization and lexical development compared to traditional pen-and-paper writing (Abuseileek, 2006). Automated feedback systems provide learners with immediate and individualized guidance on grammar and sentence structure, facilitating the development of writing accuracy over time (Xu et al., 2019). LMSs like Moodle or Google Classroom provide spaces for task delivery, assignment submission, and teacher feedback, enhancing student engagement in process writing (Zhang et al., 2022). Additionally, online writing journals and blogs promote learner voice and audience awareness while encouraging reflective practice (Soleimani et al., 2013).

These tools help develop digital literacy and promote learner autonomy—two critical competencies in academic writing and lifelong learning (Liu & Lan, 2016). When used with pedagogical intention, technology becomes not just a medium for instruction, but a scaffold for language development in the EFL writing classroom.

Web-Based Collaborative Writing (WBCW) in EFL Instruction

Web-based collaborative writing (WBCW) refers to learners jointly composing, editing, and revising texts using online technologies, such as Google Docs, wikis, blogs, or forums, in real time or asynchronously (Yim & Warschauer, 2017). Since 2009, the use of WBCW tools in college EFL writing classrooms has expanded rapidly, particularly in response to increased online learning needs (Al-Yafaei & Mudhsh, 2023).

Commonly used WBCW platforms in EFL instruction include Google Docs, wikis, blogs, forums, web-based word processors, and Tencent Docs (Li & Zhu, 2013; Sun & Chang, 2012). These tools enable synchronous and asynchronous collaboration by supporting co-editing, version tracking, commenting, and peer feedback (Li, 2018).

For adult EFL learners, Google Docs facilitates real-time co-authorship, structured peer editing, and revision transparency, making it highly effective for collaborative academic writing (Liu & Lan, 2016; Bikowski & Vithanage, 2016). Wikis promote iterative group drafting and learner responsibility for content construction over time (Li & Zhu, 2013; Wang, 2015). Blogs and forums enrich reflective writing and audience-focused peer dialogue through posted entries and comment threads (Sun & Chang, 2012). In recent years, social media has also played a role in WBCW (Hasan, 2017). Facebook groups have been utilized as collaborative writing spaces, providing learners with the opportunity to offer feedback, discuss ideas, and engage in meaning negotiation through threaded comments and shared posts (Shukor, 2014). Platforms like WeChat and Tencent Docs, which are widely used in China due to the constrained access to Google and Wiki, offer built-in resources (e.g., dictionaries, grammar checkers) and real-time collaboration. They are found to significantly enhance writing performance, motivation, and self-efficacy compared to traditional instruction (Li, 2023; Yan, 2019).

In WBCW environments, students engage in peer negotiation, self-editing, and shared decision-making that contribute to both group and individual writing gains (Lin & Maarof, 2013; Yim & Warschauer, 2017). When implemented effectively, WBCW environments provide a space for authentic communication and the co-construction of language, bridging geographical and linguistic gaps (Zhang et al., 2022). This approach enhances not only text quality and peer interaction but also learner autonomy and digital engagement (Li, 2018; Wang & Jiang, 2023). Studies have shown that WBCW in EFL writing instruction contributes to improved writing performance, increased motivation, and deeper engagement with content when paired with teacher scaffolding and appropriate task design (Bikowski & Vithanage, 2016; Strobl, 2014). As

such, WBCW stands out as a valuable instructional approach that integrates technology, collaboration, and language learning in EFL settings.

Empirical Reviews of CW and Technology Integration

Several recent reviews and meta-analyses have examined the effects of collaborative writing and educational technology on second language writing. Elabdali (2021) conducted a comprehensive meta-analysis of 33 experimental and quasi-experimental studies investigating the learning benefits of collaborative writing in L2 contexts. The analysis yielded a moderate overall effect size ($g = 0.53$), indicating that collaborative writing has a significant impact on learners' writing performance. Although the study included both face-to-face and computer-mediated CW, it did not compare their effects separately, as the focus was on the overall impact of CW versus individual writing.

Li (2018) conducted a review of 21 empirical studies on computer-mediated collaborative writing (CMCW) in L2 contexts, focusing on writing processes, outcomes, and learner perceptions. The review revealed that CMCW supports meaningful peer interaction and scaffolding, and often leads to improved content development, organization, and writing fluency. Although findings on linguistic accuracy were mixed, students generally perceived CMCW positively. While the study synthesized trends and pedagogical implications, it did not include quantitative effect sizes, distinguishing it from other meta-analytic research.

Xu et al. (2018) conducted a meta-analysis of 21 studies investigating the effects of educational technology on adult ELLs' writing performance and reported a large overall effect size ($g = 1.28$). Their analysis revealed that while both collaborative and non-collaborative tools improved writing outcomes, non-collaborative tools (e.g., automated feedback) had a greater impact on writing outcomes. Collaborative technologies such as blogs and Google Docs demonstrated moderate benefits. Xu et al. did not isolate collaborative writing as a specific instructional condition, nor did they compare technology-enhanced collaborative writing with traditional collaborative writing.

Similarly, Al-Wasy (2020) conducted a meta-analysis of 18 experimental studies on technology-integrated writing instruction, finding a very large overall effect size ($d = 1.72$) in favor of technology use. The most significant gains were observed during the drafting and editing stages, especially when all four stages of writing (prewriting, drafting, editing, and publishing) were supported. However, the study did not specifically focus on collaborative writing or web-based tools.

Focusing on online feedback, Lv, Ren, and Xie (2021) synthesized 17 studies and reported a medium-to-large effect size ($g = 0.75$) for online feedback on ESL/EFL writing quality. Teacher feedback yielded the highest effect size ($g = 2.25$), followed by peer ($g = 0.78$) and automated feedback ($g = 0.70$). While informative, their review did not isolate feedback delivered within collaborative writing tasks or compare web-based and non-digital feedback mechanisms.

In a broader synthesis, Seyyedrezaei et al. (2024) analyzed 64 studies on technology-enhanced language learning and reported a large effect ($g = 1.00$) on ESL/EFL writing performance. Moderator analyses indicated that writing genre and technology type significantly influenced outcomes. Yet, collaborative writing was not treated as an independent instructional variable, and the analysis combined both individual and group tasks.

Finally, Karabulut and Karadağ (2024) reviewed 52 studies conducted in Türkiye and found that technology-assisted instruction had a positive effect on English writing performance ($g = 0.94$), particularly when mobile-assisted tools were used. Despite this, their analysis did not distinguish collaborative from individual writing, nor did it examine the comparative benefits of web-based platforms.

Need for the Present Study

Although collaborative writing and technology-enhanced writing have each been studied extensively, few meta-analyses have explicitly focused on the comparative effects of web-based versus non-technological collaborative writing in EFL contexts. Moreover, prior syntheses have

not examined how moderating variables—such as writing genre, task duration, group size, training, and type of technology—affect outcomes in WBCW instruction. As the number of primary studies on this topic has increased in recent years, particularly following the COVID-19 pandemic (Cahyono et al., 2023; Lee et al., 2024), a focused meta-analysis is now both timely and necessary.

In particular, there is a need to investigate the effects of web-based collaborative writing among college-level EFL learners, who occupy a crucial space in both academic and professional language development. University students are expected to meet increasingly complex writing demands in English for educational purposes (EAP), including essay writing, research reporting, and discipline-specific genres (Song & Zhou, 2022). These learners often have greater exposure to instructional technology and are more frequently engaged in collaborative or process-oriented writing pedagogies than younger learners (Osama, 2021). In addition, they possess more advanced digital literacy and autonomy, which may influence how they interact with web-based platforms and benefit from collaborative tasks (Seyyedrezaei, S., et al., 2024; Cho, 2017). Understanding how WBCW interventions affect their writing outcomes can inform evidence-based instructional design and help maximize the effectiveness of collaborative technologies in higher education EFL writing contexts.

Research Questions

To address gaps in prior research, this meta-analysis synthesizes experimental and quasi-experimental studies that compare collaborative writing with and without web-based technologies among EFL college learners. Informed by emerging patterns in the literature, the analysis further examines potential moderators that may influence the effectiveness of web-based collaborative writing (WBCW), including implementation practices such as training, task-related variables like writing genre, and instructional design factors like duration. By investigating these conditions, the study aims to extend both theoretical perspectives on technology-enhanced collaboration and practical guidance for designing effective collaborative

writing interventions in EFL settings. It is guided by two research questions:

RQ1: Do web-based technology applications in collaborative writing improve college EFL students' writing performance compared to non-technological collaborative writing?

RQ2: To what extent do the following factors moderate the effects of web-based collaborative writing:

- (a) Substantive factors (e.g., genre, intervention duration, training)
- (b) Technological factors (e.g., group size, time setting, place setting)

Method

Our research questions provided the foundation for developing inclusion and exclusion criteria, as well as for designing the coding scheme and analytic procedures. As we reviewed the studies, we refined our criteria and analytic approach to accommodate edge cases. However, all decisions remained firmly anchored to the central purpose of this review: evaluating the effectiveness of web-based technology in collaborative writing instruction for EFL students in higher education contexts.

Inclusion and Exclusion Criteria

The inclusion and exclusion process was designed to ensure that the reviewed studies were methodologically sound and conceptually aligned with the scope of our investigation. If an article lacked sufficient information to determine eligibility, we attempted to contact the corresponding author. If the author did not respond or could not provide additional information, the study was excluded.

We deemed studies eligible for inclusion if they met all of the following criteria:

- 1) The study provided empirical evidence addressing one or more guiding research questions.
- 2) The report was published in English.
- 3) An experimental or quasi-experimental design was used, and for quasi-experiments, group equivalence was required at pretest.

- 4) The study involved participants identified as EFL or ESL learners in a higher education or equivalent post-secondary setting.
- 5) The treatment condition incorporated a web-based technology tool, defined as any digital platform or application that enables synchronous or asynchronous communication and shared document creation via a Wide Area Network (WAN), local area network (LAN), or an internet connection (Hew & Cheung, 2013). These technologies include tools such as Google Docs, Wikis, blogs, and cloud-based collaborative writing platforms, allowing multiple users to co-construct, revise, and comment on shared texts in real-time or asynchronously.
- 6) The comparison condition involved collaborative writing without web-based technology (e.g., face-to-face or offline).
- 7) The study included at least one measurable posttest writing outcome (e.g., writing quality, syntactic complexity, vocabulary use, text length, or content organization).
- 8) Each study had a minimum total sample size of 20 students, with at least 10 participants per condition, to allow for reliable estimation of effects (Lipsey & Wilson, 2001; Valentine et al., 2010).

We excluded studies that met any of the following criteria:

1. The treatment condition involved individual writing or peer review without collaboration on a shared written product.
2. The technology was not web-based (i.e., did not involve LAN, WAN, or internet connectivity for collective writing).
3. The study lacked a comparison group or post-intervention writing outcome.
4. The study employed only qualitative, descriptive, correlational, or observational designs without a controlled intervention.
5. The article was not an empirical study (e.g., theoretical review, commentary, editorial, or meta-analysis).

6. The necessary statistics for computing effect sizes were not reported and could not be obtained from the authors.

To ensure statistical reliability, studies were required to report a total sample size of at least 20 participants, with a minimum of 10 participants per condition, following conventions in educational meta-analysis (Lipsey & Wilson, 2001; Valentine et al., 2010). Studies were excluded if they lacked a comparison group, involved individual rather than collaborative writing, used technologies without network connectivity, failed to report writing-related outcomes, or employed non-intervention designs such as surveys, qualitative case studies, or correlational research. Studies with missing or unobtainable outcome statistics were also excluded. Attrition, fidelity, and teacher effects were coded for interpretive purposes but were not used as exclusion criteria.

Search Strategy Used to Locate Studies

A comprehensive literature search was conducted in four major databases: *ERIC*, *APA PsycINFO*, *ProQuest Dissertations & Theses A&I*, and *ProQuest Dissertations Global*. The search targeted studies involving adult learners (aged 18 and above) and spanned publications from 1990 to 2023 to align with the availability of web-based writing technologies. Boolean search strings were developed and refined across two phases. The initial search used broad terms such as *collaborative writing*, *web writing*, *online writing* and *EFL/ESL/L2*. A follow-up search incorporated platform-specific and technology-oriented keywords, including *Google docs writing*, *Wiki writing*, *Blog writing*, *Connected writing*, *Cloud-based writing* and *Synchronous writing*.

In total, 4,297 records were identified and imported into Rayyan (<https://www.rayyan.ai/>), a platform for systematic review management.

Before screening, 1,085 duplicate records were removed using a 95% similarity threshold, and 54 non-English records were excluded. This yielded 3,158 unique records for title and abstract screening. Two trained researchers independently screened 940 records for

cross-validation. Across these two rounds of co-screening, inter-rater agreement reached 98.6%, with 13 discrepancies resolved through discussion. Disagreements typically concerned borderline cases involving indirect collaboration (e.g., peer feedback without shared product) or limited technological affordances (e.g., email-based coordination).

Of the 3,158 records screened, 3,108 were excluded, and 50 records were sought for retrieval. These were supplemented by 15 records identified through manual searches of the latest, high-impact published journals in second language writing and educational technology, including *Computer Assisted Language Learning*, *Language Learning & Technology*, *Journal of Second Language Writing*, *ReCALL*, *TESOL Quarterly*, *System*, *CALICO Journal*, and *Frontiers in Psychology*. After accounting for 4 unretrieved documents, a total of 61 full-text articles were assessed for eligibility.

Based on criteria requiring a comparison between web-based and non-digital collaborative writing among EFL adult learners, 44 articles were excluded, primarily for lacking a comparison group, not addressing collaborative writing, or failing to report data for effect size calculation. Ultimately, 17 studies met all inclusion criteria and were retained for meta-analysis. A PRISMA flow diagram illustrating the full selection process is provided in Figure 1.

Coding Procedures

We developed a detailed coding protocol based on prior meta-analyses in writing and language education (Graham et al., 2012; Elabdali, 2021). Each study was coded for:

1. Study design (experimental vs. quasi-experimental),
2. Publication type (journal article vs. dissertation),
3. Student type (undergraduate, graduate, or language institute),
4. Learner characteristics (e.g., gender composition, first language background, and language setting)
5. Technology tool (e.g., Etherpad, Wiki, Google Docs, Facebook, blogging),
6. Writing genre (argumentative, informative, narrative, summary, or multiple),

7. Collaboration phase (prewriting, drafting, revising, editing),
8. Training provided (e.g., writing, technology, or both),
9. Time setting (synchronous vs. asynchronous),
10. Place setting (in-class vs. outside class),
11. Duration of intervention (in weeks),
12. Sample size and group size (number of students per collaborative group), and
13. Study quality (e.g., use of standardized outcome measures in pre-/post test, random assignment, ceiling/floor control, and reliability reporting).

Quality Assessment

To assess study rigor, we coded each included study for 11 quality features adapted from prior meta-analyses in writing and literacy education (Graham et al., 2012; Hebert et al., 2016). These included randomization, group equivalence, standardized testing, test reliability, attrition control, teacher effects, and fidelity reporting. Each feature was coded as present (1) or absent (0) (See Table 3). Besides assigning a composite score to each study, we reported the proportion of studies meeting each indicator. For instance, 94% of studies reported attrition below 10%, while only 24% used a standardized pretest. No studies reported fidelity of implementation.

Effect Size Calculation and Outlier Handling

To estimate the standardized mean differences between treatment and control groups, we used Hedges' *g* as the primary effect size metric. Hedges' *g* is preferred in meta-analyses involving small to moderate sample sizes because it corrects for positive bias in the standardized mean difference (Cohen's *d*) due to sampling error (Hedges, 1981; Lipsey & Wilson, 2001).

Studies were classified into two analytic types: (1) true experiments with random assignment and (2) quasi-experiments using intact classes or non-randomized groups. In both cases, effect sizes were computed using available posttest data and adjusted using the small

sample correction factor. For true experiments, posttest means and pooled standard deviations were used; for quasi-experiments, adjusted gain scores or pretest equivalence were applied. Effect sizes were calculated using the Campbell Collaboration's online calculator (<https://www.campbellcollaboration.org/calculator>) and verified for consistency. When descriptive statistics were unavailable, inferential statistics or graphs were used to estimate values.

When studies reported both a global essay score and domain-specific writing indicators (e.g., grammar, vocabulary, content), we applied a selection strategy to avoid redundancy and maintain consistency across the meta-analysis (Borenstein et al., 2009). In particular, we excluded composite essay scores when they were explicitly derived as a sum or average of independently reported subskills (Borenstein et al., 2009; Tanner-Smith & Tipton, 2014). For example, in Li's (2023) study, the essay score encompassed five components: content, organization, vocabulary, grammar, and language use. Including both the composite and its components would have artificially inflated that study's weight in the pooled analysis. Therefore, we retained the disaggregated domain-level indicators and excluded the essay score from the calculation of the overall effect size. This approach also enabled us to model domain-specific effects more accurately across the dataset.

Similar decisions were applied to studies by Rowan (15), Shukor (2014), and Wang (2014), where essay scores were derived from separately reported subdomains. In total, four essay-level effect sizes were removed from the original pool of 42, resulting in a final dataset of 38 unique and non-overlapping effect sizes used to calculate the overall main effect.

In cases where a single study included more than one relevant comparison group, multiple effect sizes were extracted, provided that the comparisons were statistically independent and aligned with the inclusion criteria. For example, Teng (2020) included three instructional groups: a web-based collaborative writing group (WBCW), a blended group (WBCW combined with traditional methods), and a non-technological traditional collaborative writing group. Two effect sizes were therefore computed: one comparing the WBCW group to

the traditional group, and another comparing the WBCW group to the blended group. These comparisons were treated as independent because they involved distinct intervention conditions and non-overlapping groups of participants.

To reduce distortion from extreme values, we identified outliers using a $\pm 3 \times \text{IQR}$ rule around the median (Valentine et al., 2010). This yielded cutoffs of -1.61 and 2.99. Two outliers, respectively from Jiang et al. (2021)'s study (Hedges' $g = -3.538$) and Teng (2020)'s study (Hedges' $g = 6.794$), were adjusted to the threshold values through winsorization, preserving data structure while mitigating their influence.

Statistical Analysis

All analyses used a random-effects model to account for both sampling error and between-study variability (Borenstein et al., 2009). Meta-regression was conducted using STATA with the *metareg* and *meta* packages to evaluate moderators, including writing genre, instructional duration, training, collaboration phase, and learner level.

Robust variance estimation (RVE) was applied when multiple effect sizes were derived from a single study to correct for dependence. Heterogeneity was assessed using Cochran's Q , τ^2 , and I^2 statistics. Publication bias was examined via funnel plots and Egger's regression test (Egger et al., 1997). Sensitivity analyses were conducted to assess the impact of outliers and low-quality studies on the overall effect estimate.

Publication Bias

To evaluate the potential for publication bias, we visually inspected funnel plots and conducted Egger's regression test (Egger et al., 1997). Although the small sample size limits interpretation, neither method suggests strong evidence of asymmetry. No trim-and-fill adjustments were applied.

Results

Overview of Included Studies

Table 2 provides an overview of the 17 studies included in this meta-analysis, highlighting variations in indicators such as research design, learner characteristics, instructional duration, technologies, training types, writing genres, and post-test effect sizes. These studies were conducted between 2013 and 2023 across a broad spread of EFL settings, representing learners from diverse first language backgrounds, including Persian, Chinese, Arabic, Thai, Malay, Japanese, Indonesian, and Kurdish. The majority of studies ($n = 13$) were conducted in Asia. Language use in collaborative writing tasks was consistently in English across all studies.

The total sample consisted of 1,085 EFL learners, primarily university undergraduates, with some studies also involving graduate students or learners from language institutions. Sample sizes ranged from 20 to 120 participants, with an average of approximately 64 students per study. The group sizes ranged from pairs to groups of 6, and collaboration took place synchronously or asynchronously in either in-class or remote modes. Approximately 59% of studies provided specific training in writing, technology use, or both. The interventions ranged from 1 to 16 weeks in duration, with most lasting between 10 and 16 weeks.

Various technological tools were employed across the studies. The most frequently used platforms were wikis (in 4 studies), Google Docs (in 3 studies), blogging tools (in 2 studies), and Facebook (in 2 studies). Other tools included Etherpad, Moodle, WeChat, Tencent Docs, Wikispaces, and Ebeam. Writing genres included argumentative ($n = 11$), informative ($n = 5$), narrative ($n = 1$), summary writing ($n = 1$), and mixed genres ($n = 1$). All studies were either quasi-experimental or true experimental in design. More than half were published in peer-reviewed journals after 2015. The studies employed diverse quality control methods, and the average quality score across studies was 0.67 (based on an 11-point scale), with all studies reporting clear pre- and post-test comparisons.

Post-test effect sizes across the studies ranged from -3.538 to 6.79, with most studies reporting moderate to strong positive effects for WBCW compared with non-technological collaborative writing conditions. Although two studies reported large effect sizes, most of them fell within the expected range for writing interventions. This variability highlights the importance of considering task type, learner characteristics, and instructional design when evaluating the effectiveness of WBCW.

Study Quality

Study quality was assessed using 11 methodological indicators, including the use of standardized tests, control of teacher effects, and reporting of attrition (See Table 2). Quality scores ranged from 0.36 to 0.91, with an average score of 0.67. Only two studies employed random assignment, and none reported fidelity of implementation. However, most studies addressed pre- and post-test floor or ceiling effects (82–94%), and 88% reported inter-rater reliability above 0.60.

Control of teacher effects was limited; only 18% of studies ($n = 3$) explicitly accounted for potential teacher influence across conditions. Attrition was generally well reported, with 94% of studies reporting attrition rates below 10%, and most showing balanced dropout across conditions. Despite an overall moderate to high quality, the absence of fidelity checks and inconsistent reporting on training and teacher influence limit causal claims and highlight areas for improvement in future research.

RQ1: Do web-based technology applications in collaborative writing improve college EFL students' writing performance compared to non-technological collaborative writing?

Effect Results

Overall Effect of Web-Based Collaborative Writing. A random-effects meta-analysis using robust variance estimation (RVE) was conducted to assess the overall impact of web-based collaborative writing (WBCW) interventions on EFL students' writing outcomes. Across 38 effect sizes from 17 studies, the pooled effect was statistically significant, with

Hedges' $g = .51$, $p = .012$, 95% CI [0.13, 0.89], indicating a moderate and reliable advantage for technology-enhanced collaborative writing compared to traditional face-to-face collaboration. When analysis was restricted to 17 effect sizes reporting essay score outcomes, the effect was slightly more substantial ($g = .83$, $p = .0001$, 95% CI [0.48, 1.19]), suggesting that WBCW may be especially beneficial in improving holistic writing performance.

Although variation existed, most effect sizes were positive and clustered in the small to moderate range. A few studies, such as those by Bagherpour et al. (2017) and Jiang et al. (2021), reported negative or near-zero effects, which may reflect differences in instructional design, duration, or learner familiarity with digital tools.

The RVE model also revealed substantial heterogeneity. The estimated between-study variance was $\tau^2 = 0.337$ for the overall analysis and $\tau^2 = 0.470$ for the essay score subset, indicating considerable variation in effects across studies. While RVE does not yield traditional Q or I^2 statistics, the magnitude of τ^2 suggests that the effectiveness of WBCW is influenced by study-level characteristics such as population, training conditions, and implementation features. This heterogeneity underscores the importance of conducting moderator analyses to understand better what works, for whom, and under what instructional contexts.

Domain-Specific Outcomes. To examine the differential impact of web-based collaborative writing (WBCW) on various aspects of writing, effect sizes were grouped into four domains: overall essay quality, grammar, vocabulary, and content.

The majority of studies assessed essay quality and yielded consistently positive effects. A smaller number of studies reported outcomes related to grammar ($k = 5$), vocabulary ($k = 4$), and content quality ($k = 4$), resulting in lower statistical power for domain-specific estimates.

The grammar domain showed a statistically significant pooled effect ($g = 0.79$, $p = .0045$), suggesting that WBCW may be particularly effective in enhancing writing accuracy. Given the persistent challenges EFL learners face in grammar, this finding is noteworthy. However, due to the small number of studies and low degrees of freedom ($df = 3.37$), the result should be

interpreted with caution. Still, the strength of the coefficient and narrow confidence interval point to genuine potential, underscoring the need for more grammar-focused collaborative interventions in future research.

The vocabulary outcome produced a non-significant effect ($g = 0.46$, $p = .213$), yet the magnitude of the coefficient still indicates a moderate and potentially meaningful benefit. Similarly, content quality yielded a moderate effect size ($g = 0.61$, $p = .069$), which, although statistically non-significant, may reflect WBCW's value in supporting idea development and organizational clarity. As with grammar, the degrees of freedom for vocabulary ($df = 2.84$) and content ($df = 2.96$) were too low to allow firm statistical conclusions. Nonetheless, the positive direction and moderate size of the coefficients across all domains suggest that WBCW may foster multiple dimensions of writing proficiency. These findings highlight promising trends that warrant replication and further exploration with larger datasets.

RQ2: To what extent do the following factors moderate the effects of web-based collaborative writing:

- (a) Substantive factors (e.g., intervention duration, genre, training)
- (b) Technological factors (e.g., group size, time setting, place setting)

Moderator Analyses

To examine potential sources of variation in the effects of web-based collaborative writing (WBCW), moderator analyses were conducted across six variables: training, genre, duration, time setting, place setting, and study quality. These moderators reflect both instructional features and study design characteristics that may shape the impact of collaborative writing interventions.

Training. Among all moderators, training was the only one to yield a statistically significant difference for essay-level outcomes. Studies that incorporated explicit instruction—either in collaborative writing strategies, technological tool use, or both—showed significantly larger effect sizes ($p = .028$). This suggests that structured guidance enhances

students' ability to use web-based platforms meaningfully and engage productively with peers. In WBCW contexts, such training likely supports not only technical navigation but also collaborative behaviors, such as giving peer feedback, revising jointly, and managing co-authorship.

Interestingly, when training was examined as a moderator across all outcome types, the effect was not statistically significant ($p = .116$), yet the coefficient was relatively large ($b = 0.74$). This may indicate a potential trend worth further investigation. Although the current evidence is insufficient for firm inferential claims, the direction and magnitude of the estimate tentatively suggest that integrating instruction in both collaborative writing strategies and tool use might improve the effectiveness of WBCW interventions. This pattern aligns with prior instructional recommendations and may provide a basis for developing more focused studies. As such, the finding may help expand future research designs and hypotheses related to how training supports learner engagement and collaborative writing development in digital contexts.

Genre. Genre did not significantly moderate the effects of WBCW ($p = .462$). However, the model revealed a relatively strong coefficient for genre comparisons ($b = 0.71$), indicating that certain writing types—particularly argumentative writing—may benefit more from WBCW than others. While argumentative writing was the most commonly used genre (over 60% of studies), and the overall pattern suggests broad effectiveness across genres, the magnitude of the coefficient points to a practical trend worth noting: collaborative writing may be particularly compatible with genres that require structured reasoning, discourse organization, and idea negotiation. These features align well with the affordances of digital platforms and peer collaboration, suggesting that genre-task alignment could further optimize WBCW's instructional value.

Duration. Instructional duration ranged from 2 to 20 weeks across the included studies, but no significant moderation effect was found ($p = .786$). This suggests that both short-term and longer WBCW interventions can lead to positive outcomes, provided that tasks are

well-structured and designed to achieve specific goals. In EFL contexts, even short collaborative writing projects may provide sufficient opportunities for peer feedback, revision, and language scaffolding. Longer interventions, while offering extended exposure, may not necessarily outperform shorter ones unless paired with iterative task cycles or progressive scaffolds.

Time Setting. The distinction between synchronous and asynchronous collaboration also did not significantly moderate effects ($p = .894$). This finding highlights a key strength of WBCW: its adaptability to various instructional schedules. Whether students work together in real time (e.g., live document editing) or across time (e.g., through cloud platforms and threaded comments), the collaborative writing process remains pedagogically effective. This flexibility is particularly valuable in EFL programs with mixed scheduling formats or online components.

Place Setting. Similarly, no significant differences were found between in-class and outside-class collaborative writing ($p = .841$). This result reinforces the idea that WBCW is not constrained by physical space and can be implemented successfully beyond traditional classroom boundaries. EFL learners working from home or in online courses may benefit equally from web-based writing tasks, provided that the collaborative structures and supports remain in place.

The consistency across time and place moderators supports the view of WBCW as a pedagogically robust and logistically flexible approach, well-suited to contemporary instructional environments that blend face-to-face, online, and asynchronous elements.

Group Size. A moderator analysis was also conducted to explore whether group size influenced the effectiveness of WBCW. Group size was coded as 1 for pairs and 0 for groups of three or more. Using robust variance estimation (RVE), the analysis yielded a non-significant effect ($p = .176$) but a relatively large coefficient ($b = 0.732$), with a wide 95% CI $[-0.391, 1.837]$. Since the analysis did not yield a statistically significant moderator effect, for future studies, this result must be interpreted cautiously given the non-significance and wide confidence interval. At the same time, the strength and direction of the coefficient may offer a useful exploratory signal,

encouraging researchers to broaden research designs and generate new insights into how group size structures affect writing collaboration.

Sensitivity Analysis

To assess the robustness of the findings, a sensitivity analysis was conducted by removing the most extreme effect size (Teng, 2020; $g = 6.79$). With this study excluded, the overall mean effect size decreased slightly to $g = 0.44$, but the result remained statistically significant ($p < .05$). This suggests that the positive effects of web-based collaborative writing are not solely driven by outlier studies.

Publication Bias

To evaluate the presence of publication bias, a funnel plot was generated using observed effect sizes and their corresponding standard errors. The distribution of studies appeared reasonably symmetrical around the estimated mean effect size, with no clear indication of missing studies on either side. This visual inspection suggests a low likelihood of publication bias.

To further assess small-study effects, Egger's regression test was conducted. The result was not statistically significant ($p = .315$), indicating that the observed effect sizes were not systematically associated with their standard errors. This suggests the absence of substantial bias due to selective reporting of statistically significant results.

Although a formal trim-and-fill procedure could not be fully implemented, a funnel plot approximating its structure was produced. The central red line represents the random-effects estimate of the overall effect, and the dashed lines indicate the pseudo 95% confidence region. The majority of the studies fell within this region, with no apparent clustering on one side. Together, these results support the robustness of the meta-analytic findings and indicate that publication bias is unlikely to have significantly distorted the conclusions.

Discussion

This meta-analysis investigated the effects of web-based collaborative writing (WBCW) on the writing performance of EFL learners, with a particular focus on comparing WBCW to non-technological forms of collaborative writing. While previous research has commonly examined the effectiveness of collaborative writing compared to individual writing, or the use of technology in writing instruction more broadly, relatively few studies have isolated the specific contribution of technology within collaborative writing itself. This study aims to address a gap in the literature by synthesizing findings from studies that directly compare collaborative writing with and without web-based tools, thereby enhancing our understanding of the added pedagogical value that technology may bring to collaborative writing processes in EFL contexts.

The meta-analytic results revealed a statistically significant positive overall effect for WBCW, indicating that technology-supported collaboration can lead to stronger writing outcomes than traditional face-to-face collaboration alone. This aligns with prior findings on the effectiveness of collaborative writing in second language instruction (Storch, 2013) and the broader body of evidence supporting the integration of digital tools in writing pedagogy (Graham & Perin, 2007). Rather than simply replicating existing collaborative practices, WBCW appears to enrich them by introducing new affordances for engagement, revision, and feedback.

These findings are situated within the framework of Computer-Assisted Language Learning (CALL), which emphasizes the potential of digital environments to enhance language development through interaction, scaffolding, and learner autonomy (Chapelle, 2001; Warschauer, 2006). Tools commonly used in WBCW—such as Google Docs and Wikis—provide shared writing spaces, real-time feedback, and revision tracking, which can facilitate more visible and sustained collaboration (Kessler, 2009; Li & Zhu, 2017). Compared to traditional collaborative writing, which often depends on fleeting oral exchanges or hand-written

drafts, WBCW supports asynchronous participation, clearer text ownership, and iterative development (Yim & Warschauer, 2017; Zhang et al., 2021).

In line with these affordances, earlier research has shown that collaborative digital writing can enhance metacognitive awareness, peer feedback quality, and learner responsibility in the writing process (Elola & Oskoz, 2010; Storch, 2011). These process-oriented benefits suggest that WBCW not only improves writing outcomes but may also influence how learners conceptualize writing—as a socially negotiated and strategically managed activity. The present meta-analytic findings contribute to this growing body of evidence by quantifying the advantages of WBCW over traditional collaboration and highlighting its potential to reshape writing instruction in EFL contexts, especially for college level teachers and learners.

One meaningful instructional insight from this analysis lies in the role of training. Studies that offered combined training in writing strategies and tool use, teaching students both how to write collaboratively and how to navigate digital platforms, tended to yield more potent effects. This suggests that simply giving students access to technology is insufficient; instructional planning must deliberately scaffold both the writing task and the collaborative process. The success of WBCW depends on students' ability to coordinate roles, offer meaningful feedback, revise jointly, and use platform features (e.g., comments, revision history) purposefully.

In contrast, several moderator variables like time setting (synchronous vs. asynchronous), place setting (in-class vs. outside-class), writing genre, and task duration did not yield statistically significant differences in effect size. However, the implications of these non-significant results are pedagogically important. For example, the consistent effectiveness of WBCW across time and place settings suggests that the benefits of digital collaboration are not dependent on specific delivery modes. WBCW appears equally effective whether students collaborate in real time during class or asynchronously outside of it. This flexibility broadens the range of instructional contexts in which WBCW can be used effectively, including online courses, hybrid models, and flipped classrooms.

The genre moderator was also non-significant, indicating that WBCW can be applied across different types of writing tasks without risking reduced impact. However, many of the included studies focused on argumentative and informative writing, genres that inherently benefit from peer discussion and revision. These writing types encourage students to engage with logic, structure, and clarity, which are well-suited to collaborative negotiation. While no statistically significant genre advantage was detected, the prevalence of these genres in higher-performing studies suggests that they may naturally align with the strengths of collaborative writing.

Likewise, writing duration did not significantly moderate outcomes, suggesting that both short-term and extended WBCW interventions can be beneficial. This suggests that when well-designed, even brief collaborative projects can yield measurable improvements in writing, although longer-term tasks may offer additional opportunities for feedback, reflection, and recursive revision.

An additional outcome domain explored in this study was grammar accuracy. The meta-analysis indicated a statistically significant effect for grammar outcomes; however, due to the small number of studies and very low degrees of freedom, this result must be interpreted with caution. It would be premature to claim that WBCW reliably improves grammatical accuracy across contexts. Still, the result is worth noting as a promising exploratory finding. Collaborative environments prompt learners to attend more closely to form, especially when revising with peers or responding to targeted feedback. Future research with a larger pool of grammar-focused studies is needed to confirm whether these effects are consistent and replicable.

Overall, the findings support the view that WBCW is a robust, flexible, and pedagogically sound approach to writing instruction in EFL contexts. Its effectiveness across diverse task types, instructional settings, and delivery formats suggests that WBCW can meet a range of learner needs while fostering more interactive and engaged writing classrooms. The results also

point toward important conditions for maximizing its impact, namely the inclusion of clear instructional scaffolding, integrated training, and thoughtful task design. While certain findings remain exploratory, they open pathways for future instructional experimentation and research, particularly in underexplored areas such as grammar development and multimodal writing.

Limitations and Future Applications

Limitations

This meta-analysis has several limitations that warrant consideration and align with patterns observed in prior meta-analyses on writing interventions (e.g., Graham et al., 2013). First, although the overall and essay-specific effects of WBCW were statistically significant, the number of studies reporting outcomes in grammar, vocabulary, and content was small. Particularly in the domain-specific analyses, degrees of freedom often fell below acceptable thresholds, limiting the inferential power of these estimates. While the observed effects were promising, they should be interpreted as exploratory rather than conclusive.

Second, while moderator analysis provided insights into variables such as training, genre, and group size, most moderators did not reach statistical significance. However, several showed strong coefficients, suggesting that practical variation exists but could not be reliably detected due to small subgroup sample sizes and wide confidence intervals. This issue reflects a broader limitation in meta-analyses with constrained study pools (Graham et al., 2012), where high between-study variance (as indicated by τ^2) is difficult to fully explain.

Third, all included studies were conducted in college or adult EFL contexts, including universities and language institutes. This institutional focus was intentional to maintain contextual consistency, but it also limits the generalizability of the findings to secondary or K–12 populations. As noted in previous meta-analyses, the effects of writing interventions may differ across age groups due to variation in cognitive development, peer dynamics, and instructional infrastructure. Additionally, the narrow institutional scope may have constrained the diversity of tasks and tools used, limiting the range of implementation designs represented in the dataset.

Finally, variation in reporting quality across primary studies made it difficult to analyze factors such as instructor involvement, feedback cycles, or fidelity of implementation. While robust variance estimation (RVE) accounts for clustering and dependence, improved methodological transparency (e.g., the reporting of pre- and post-equivalence, training structure, and tool functionality) is needed to refine future meta-analyses and their practical relevance (Gersten et al., 2005; Vuogan & Li, 2023).

Future Pedagogical Applications

Given that all included studies were conducted in college or institutional EFL settings, the pedagogical implications of this meta-analysis primarily target university-level writing instructors, curriculum designers, and program developers. The consistent benefits of web-based collaborative writing (WBCW) across contexts point to several instructional recommendations:

Adopt WBCW as a Core Instructional Approach. Rather than using digital collaboration as an occasional tool, instructors should embed WBCW within the core structure of EFL writing courses. Tasks such as co-authoring argumentative essays, conducting collaborative revisions, and engaging in peer feedback sessions are ideally suited to this format and can be implemented across different genres and proficiency levels.

Use Tools That Support Collaborative Processes. Platforms like Google Docs, Tencent Docs, or Wikis should be selected not just for convenience but for their affordances—shared editing, real-time commenting, and revision tracking. These features encourage process-based writing, allowing learners to iteratively plan, write, revise, and reflect with peers.

Provide Integrated Training in Tool Use and Collaboration. The effectiveness of WBCW increases significantly when students are trained not only in how to use the platform but also in how to collaborate effectively. Instructors should provide modeling, task-specific rubrics,

and structured peer review protocols. Early training should focus on co-authorship strategies, feedback etiquette, and tool-specific features like commenting or version control.

Capitalize on Temporal and Spatial Flexibility. WBCW proved effective regardless of time setting (synchronous vs. asynchronous) or place setting (in-class vs. out-of-class). This flexibility allows instructors to extend writing instruction beyond fixed class periods and supports hybrid or online teaching formats without compromising collaborative engagement.

Consider Group Size Based on Task Complexity. Although not statistically significant, strong coefficients suggested that smaller groups (especially pairs) may result in greater learning benefits. Instructors are encouraged to tailor group sizes to task demands, using dyads for intensive revision tasks and small groups for projects requiring diverse input.

Design Tasks That Target Writing Subskills. Findings in grammar, content, and vocabulary domains suggest that WBCW may support development beyond general essay quality. Teachers can design scaffolded tasks that explicitly focus on one or more of these subskills through peer editing, targeted revision prompts, or collaborative sentence reconstruction.

Future Research Directions

This meta-analysis also highlights several areas where additional investigation is needed to strengthen the evidence base and guide future WBCW implementation:

Expand to Underrepresented Populations and Contexts. All included studies targeted college-level learners, leaving a gap in understanding how WBCW operates in secondary schools, vocational programs, or community-based language learning. Future studies should explore how age, educational level, and institutional setting influence the effectiveness of WBCW.

Increase Methodological Transparency. Many studies lacked detailed reporting on fidelity of implementation, teacher involvement, or tool-specific usage. Future research should

include transparent protocols that describe instructional procedures, technological scaffolds, and revision tracking to support replication and synthesis.

Investigate Interactions Among Moderators. While training, group size, and genre showed promising coefficients, most moderator effects were statistically non-significant due to limited statistical power. Larger datasets could enable multi-level modeling of how moderators interact such as whether argumentative writing is more effective when paired with smaller groups or whether training mitigates challenges in asynchronous settings.

Differentiate Task Types and Collaboration Structures. Not all collaborative writing tasks are the same. Future studies should isolate the effects of specific collaboration models (e.g., rotating peer roles, structured peer response, co-drafting) and investigate how different tools facilitate these structures.

Examine the Process, Not Just the Product. Most studies focused on writing outcomes rather than on how collaboration unfolded. Future research should incorporate process-tracing methods (e.g., chat logs, document histories, revision frequency) to better understand how students negotiate, revise, and support one another in digital writing environments.

Conclusion

This meta-analysis provides evidence that web-based collaborative writing (WBCW) significantly improves college EFL learners' writing outcomes compared to traditional face-to-face collaborative writing. The results demonstrate the pedagogical value of WBCW as a flexible, scalable approach that supports diverse instructional formats, including synchronous and asynchronous collaboration.

Although most moderator variables did not reach statistical significance, patterns in the data suggest that group size and training are promising areas for instructional focus. These findings highlight the importance of deliberate instructional design, including integrated training in both collaborative strategies and digital tools.

Despite limitations related to small moderator subgroup sizes and inconsistent reporting

of implementation fidelity, the results underscore the potential of WBCW to enhance student engagement and writing performance. Future research should examine domain-specific outcomes (e.g., grammar, vocabulary) and explore WBCW in underrepresented learner populations, such as high school students and beginner EFL writers.

CHAPTER 4 Chinese Teachers' Perceptions of Technology Integration in EFL Writing Instruction Since the Pandemic: A Thematic Analysis

Abstract

This qualitative study explores Chinese university EFL writing instructors' perceptions and practices regarding technology integration in writing instruction, focusing on the post-pandemic shift to hybrid learning and the growing influence of Generative Artificial Intelligence (GenAI). Grounded in the Technological Pedagogical Content Knowledge (TPACK) and Pedagogical Content Knowledge (PCK) frameworks, the study investigates how digital tools are adopted and adapted in writing pedagogy, ranging from automated feedback platforms like Pigaiwang and Peerceptiv to GenAI tools such as ChatGPT, Wenxin Yiyan, and Doubao. Data were collected through background questionnaires and semi-structured interviews with seven writing instructors across universities of varying tiers and regional development levels in China. Thematic analysis revealed three key themes: technology integration in writing instruction, the changing perceptions of digital tools since the pandemic, and the emergent role of GenAI in writing practices. Findings suggest that TPACK and PCK levels, institutional support, and regional context influence technology use in EFL writing instruction. Meanwhile, challenges remain regarding classroom engagement, uneven technology access, and ethical and professional guidance. The study highlights the importance of context-sensitive teacher training and institutional policies to support meaningful and equitable technology integration in EFL writing instruction.

Keywords: EFL writing instruction; TPACK; PCK; GenAI; China; teacher perceptions; technology integration; hybrid teaching, COVID-19

Introduction

Digital technologies have increasingly reshaped English as a Foreign Language (EFL) pedagogy, particularly in writing instruction, where tools such as automated feedback platforms, online peer review systems, and generative artificial intelligence (GenAI) now play vital roles (Yunus et al., 2012; Al-Wasy, 2020). The COVID-19 pandemic accelerated this shift, pushing universities worldwide to adopt online teaching methods and digital writing tools at an unprecedented pace (Trust & Whalen, 2020). This rapid transition revealed not only the possibilities of digitally mediated instruction but also the structural, pedagogical, and psychological challenges it brings (Canals & Al-Rawashdeh, 2019).

With the largest EFL learning population in the Chinese context, writing instruction has undergone a similar transformation, with instructors adopting platforms such as Pigaiwang to supplement traditional classroom practices (Zhang, 2021). However, despite broad technology adoption, research often focuses on students' outcomes and tool efficacy, leaving gaps in understanding how teachers perceive and integrate these technologies pedagogically (Nguyen, 2023; Lo et al., 2024). Moreover, few studies have explored how contextual factors—such as institutional tier, regional development, and teacher training—shape technology use in EFL writing instruction.

This study draws on the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006) and the concept of Pedagogical Content Knowledge (PCK; Shulman, 2006) to explore how university EFL writing instructors in China perceive and use digital tools in their classrooms. TPACK emphasizes the integration of content, pedagogy, and technology in effective instruction, while PCK highlights the importance of aligning teaching methods with student learning needs. These frameworks support the study's aim of understanding what tools teachers use and how and why they use them in response to instructional goals and student engagement.

Using a qualitative thematic analysis approach (Braun & Clarke, 2006), the study examines the experiences of seven Chinese university writing instructors across institutions of varying tiers and regions. It investigates their views on digital tool usage, their adaptation to online teaching during and after the pandemic, and their perceptions of generative artificial intelligence (GenAI) tools in writing pedagogy. By focusing on the participants' perceptions and contextual diversity, this study contributes to a more nuanced understanding of technology integration in EFL writing instruction to address the following research questions:

1)How do writing teachers in Chinese universities perceive the existing technologies that support their writing pedagogy and practices?

2)In what ways have the adoption and perceptions of Chinese writing teachers on technology in writing instruction evolved since the pandemic?

3)How do writing teachers in Chinese universities perceive the future trend of new teaching modes and technologies toward writing pedagogy and practices?

Literature review

This study examines teachers' adoption and perceptions of technology in English as a Foreign Language (EFL) writing instruction, guided by the Technological Pedagogical Content Knowledge (TPACK) framework. The literature addresses three areas: (1) technology integration in EFL writing instruction, (2) teachers' perceptions of technology use, and (3) the adoption of GenAI tools in EFL writing pedagogy.

Theoretical Framework

This study is grounded in the Technological Pedagogical Content Knowledge (TPACK) framework developed by Mishra and Koehler (2006), which defines effective technology integration as the intersection of three core domains: content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK). CK refers to a teacher's expertise in subject matter—in this case, English writing skills such as grammar, discourse structures, and genre conventions. PK involves knowledge of effective teaching methods, including instructional

strategies, scaffolding, and feedback approaches tailored to students' needs. TK encompasses the ability to select and use digital tools—such as automated feedback platforms, AI writing assistants, and communication software—to enhance teaching and learning.

TPACK offers a lens for analyzing how teachers integrate technology meaningfully by aligning it with content and pedagogy. It also supports exploring teachers' decision-making in technology-enhanced EFL writing instruction. In addition, this study draws on Shulman's (2006) concept of Pedagogical Content Knowledge (PCK), which highlights teachers' understanding of how students learn specific content. PCK informs the study's attention to student engagement and teacher-student interaction in online environments. Together, TPACK and PCK enable a deeper investigation into the tools teachers use and how and why they utilize them in relation to instructional goals and student learning processes.

Integrating TPACK and PCK is particularly relevant in digital learning environments, where teachers must make nuanced decisions about aligning technological tools with content-specific objectives and learner needs. Chai et al. (2013) emphasized in their review that the TPACK framework is beneficial for identifying gaps in teachers' combined knowledge domains and evaluating the alignment between digital tools and their pedagogical strategies. Their findings suggest that teachers often require targeted support to develop integrated knowledge rather than isolated competencies in technology or pedagogy.

In the EFL context, Cheung and Jang (2020) analyzed how in-service English writing teachers developed TPACK-informed practices by examining their classroom implementation over time. Their study revealed that while teachers showed willingness to integrate digital tools, their usage was often shaped by fixed assessment practices and exam-oriented instruction. These constraints limited teachers' ability to apply more creative or collaborative digital strategies, resulting in technology use that reinforced traditional writing routines rather than transforming them. Similarly, Sariçoban et al. (2019) evaluated the TPACK competence of pre-service EFL teachers in Turkey, finding that while most participants demonstrated strong

content and pedagogical foundations, they struggled to incorporate technology beyond surface-level presentation tools or isolated apps in a meaningful way.

Recent studies have also emphasized the importance of teachers' understanding of their students, a key dimension of PCK, in shaping effective technology use. Wu and Wang (2015), for instance, found that Taiwanese primary EFL teachers with higher PCK adapted digital tools more thoughtfully to suit learner proficiency levels, motivation, and learning styles. Complementing this, Tseng (2016) developed and validated a student-perception-based instrument, allowing EFL learners to assess how well their teachers aligned technology use with instructional content and learning needs. The results showed that students were more responsive to teachers who used technology to scaffold complex writing tasks and provide interactive feedback rather than those who employed it for procedural delivery alone.

In this study, TPACK and PCK jointly inform the research design. They provide a lens for understanding what knowledge EFL teachers need to select, adapt, and align technological tools, such as AI writing assistants and online platforms, with instructional and student-centered goals (Koehler et al., 2013; Voogt et al., 2013). The framework guided the development of both the questionnaire and interview protocol and also structured the thematic analysis of how teachers make pedagogical decisions in technology-mediated EFL writing instruction (Xu & Zammit, 2020).

Technology Integration in EFL Writing Instruction

Digital tools, from automated feedback systems to collaborative writing platforms, are increasingly used to support EFL writing instruction (Al-Wasy, 2020). For example, grammar-checking software like Grammarly can significantly reduce errors and improve students' writing quality (Karyuatry, 2018). A study by Fitria (2021) showed that students' writing scores more than doubled after using an AI-based checker, indicating marked improvements in grammar and clarity. Likewise, integrating social media and online collaborative tools into writing

tasks can broaden learners' content knowledge, boost motivation, and build confidence in writing (Yunus et al., 2012).

However, technology integration practices vary widely. Some EFL writing teachers extensively use writing blogs, chat tools, and online peer review, while others use technology minimally or only for administrative convenience (Baskara, 2023). Studies have identified several constraints behind its limited use: large class sizes and limited computer access, lack of training and technical support, and teachers' uncertainty about effective pedagogical integration (Hedayati & Marandi, 2014; Yunus et al., 2012). Such findings underscore that successful integration of technology in writing instruction depends not only on the tools themselves but also on teacher readiness and supportive conditions.

Despite growing interest in technology-enhanced EFL writing instruction, current research often focuses on the effectiveness of tools or student outcomes rather than teachers' instructional decision-making. Few studies examine how writing instructors integrate multiple tools in response to content goals, classroom realities, or learner diversity. These limitations highlight the need for research that examines how EFL writing teachers utilize technologies to align with their pedagogical intentions.

EFL Teachers' Perceptions of Digital Tools and Online Teaching

Teachers' beliefs and attitudes are pivotal in how technology is used in EFL classrooms (Albirini, 2006). The rapid transition to online instruction during the COVID-19 pandemic brought these perceptions into sharp focus. Many educators initially felt unprepared and anxious when using unfamiliar platforms, underscoring the importance of prior ICT training and institutional support (Canals & Al-Rawashdeh, 2019). Technical barriers, lack of training, and fear of failure often discouraged teachers from fully engaging with digital tools in the early stages (Saleh & Meccawy, 2022).

However, ongoing exposure to digital platforms gradually improved teachers' confidence. For example, Cheung (2021) found that Hong Kong secondary school teachers, after months of

online teaching, began to explore more interactive tools such as Padlet and Zoom breakout rooms to increase student engagement. Similarly, Manegre and Sabiri (2022) reported that a majority of English instructors believed online instruction had the potential to foster flexible, student-centered learning environments, especially when instructors adapted pedagogical strategies to fit virtual formats.

At the same time, challenges persisted. Teachers frequently reported increased workload, difficulty tracking student participation, and a lack of clear guidelines for digital classroom management (Ertmer et al., 2012; Saleh & Meccawy, 2022). Instructors with limited digital literacy often defaulted to lecture-based formats in online settings, limiting opportunities for interaction (Aliyyah et al., 2020). Even when tools were available, effective pedagogical use remained uneven.

Cross-national studies reinforce that teachers only integrate technology meaningfully when they feel competent and supported. In countries like Turkey, Syria, and Jordan, educators have expressed willingness to adopt technology, but only when institutions offer sustained professional development, technical infrastructure, and clear expectations (Albirini, 2006; Alghamdi & Holland, 2020; Canals & Al-Rawashdeh, 2019). Without such support, teachers often remain cautious and revert to traditional methods.

Overall, the shift in instruction modes since the pandemic has heightened EFL teachers' awareness of digital tools' possibilities and limitations. Although they have become more open to digital tools since the pandemic, existing studies often focus on general attitudes rather than discipline-specific practices. For instance, how EFL writing teachers integrate tools into pedagogy or respond to institutional and student needs.

Adoption of GenAI in EFL Writing Instruction

The rise of GenAI tools, particularly ChatGPT, has introduced promise and complexity in EFL writing pedagogy. AI-based writing assistants can provide students with real-time feedback on grammar, coherence, and vocabulary, supporting iterative learning and improving fluency

(Polakova & Ivenz, 2024). Many learners report increased confidence and reduced writing anxiety when using ChatGPT as a tool for drafting and revision (Nguyen, 2023). Teachers have also noted time-saving benefits and the potential for AI to support weaker writers through personalized suggestions (El Sayary, 2024). Some instructors have begun designing AI-integrated writing tasks, such as critical comparison exercises between student-generated and AI-generated drafts, to promote reflective learning (Tian & Wang, 2024).

Despite these advantages, ethical and pedagogical concerns persist. Educators express growing concerns about plagiarism, skill erosion, and students' overreliance on AI-generated output (Hang, 2023). Moreover, questions remain about the pedagogical alignment of AI content with classroom objectives, especially in assessment contexts where independent writing ability is being evaluated (Gao & Zhang, 2023). Teachers also caution that AI feedback may be contextually inappropriate or linguistically misleading if students use it without critical evaluation (Lo et al., 2024). Compounding these concerns is the lack of clear institutional guidelines for the use of AI in writing instruction, leaving many educators to make classroom decisions based on personal judgment.

Notably, as GenAI becomes a global phenomenon, there is a growing need to examine its impact across diverse educational contexts and platforms. Much of the current literature focuses on English-medium, globally available AI tools, whereas local equivalents have received comparatively little attention. For example, in China, where access to ChatGPT is restricted, domestic GenAI tools such as Wenxin Yiyan (developed by Baidu) and Doubao (developed by ByteDance) have emerged as alternatives in educational settings. Recent studies have begun to explore their integration into English language education. Zhang et al. (2024) found that Wenxin Yiyan supported Chinese undergraduates' academic English writing by providing AI-generated scaffolding and feedback, leading to improved learner engagement. Similarly, Zhou's (2024) case study on Kimi AI found that its application in English classrooms enhanced instructional efficiency and stimulated students' intercultural communication. These

findings suggest that local GenAI tools hold promise for supporting EFL instruction in China, yet their pedagogical roles and long-term impact remain underexplored in current research. This gap highlights the need for studies examining how EFL teachers utilize these local tools in authentic teaching contexts.

Building on the existing literature, this study aims to explore how Chinese university EFL writing instructors perceive and adopt digital tools, including emerging AI technologies, in technology-mediated writing instruction since the pandemic. Guided by the TPACK and PCK frameworks, it employs a qualitative design consisting of a teacher questionnaire and semi-structured interviews to examine the interplay between teachers' technological knowledge, pedagogical strategies, and content goals. While previous studies have often focused on student outcomes or single tools, this research centers on teachers' integrated practices and decision-making in classroom contexts. It also expands the scope of investigation by including Chinese-developed GenAI tools, which are currently underrepresented in the global literature. By examining both the affordances and limitations of digital tool use in EFL writing instruction, this study aims to contribute a context-sensitive understanding of how teachers navigate the complexities of online pedagogy, adapt technology to meet learner needs and integrate evolving digital platforms and tools into their instructional practices.

Method

This study adopts a qualitative approach to exploring Chinese EFL teachers' integration of technology in writing instruction. To examine teachers' experiences and perspectives, the research follows a six-step thematic analysis framework (Braun & Clarke, 2006). Data were collected through semi-structured interviews and background questionnaires.

Sampling and Data Saturation

Since the researcher is based in the U.S., recruiting Chinese EFL teachers for in-depth interviews was challenging. Given the nature of this research, data saturation was a key

consideration in sampling and data collection, which aimed for no new themes or insights to emerge from additional data collection (Guest et al., 2006).

The selection of universities and teachers was made strategically to maximize data saturation within constraints. The sample includes institutions from different tiers, regions, and academic foci to capture a range of technological adoption experiences. Table 1 summarizes the university selection criteria.

Table 3.1 Institutional Profiles

University	Tier	Type	Location	Regional SES
Peking University (PKU)	Top Tier	Comprehensive	Beijing	Developed
Zhejiang University (ZJU)	Top Tier	Comprehensive	Hangzhou, Zhejiang	Developed
China Normal University (CNU)	Second Tier	Normal (Teacher Training)	Beijing	Developed
Southwest Minzu University (SWMU)	Second Tier	Ethnic & Comprehensive	Chengdu, Sichuan	Less Developed
Northeast Normal University (NENU)	Second Tier	Normal (Teacher Training)	Changchun, Jilin	Less Developed
Ningbo Institute of Technology (NIT)	Third Tier	Engineering-Focused	Ningbo, Zhejiang	Developed

This selection ensures a representative range of elite universities (PKU, ZJU), second-tier institutions (CNU, SWMU, NENU), and a third-tier technical university (NIT). The sample also captures regional diversity, including universities from both highly developed regions (Beijing and Zhejiang) and less developed areas (Sichuan and Jilin). Instructors across different institutions and regions reported similar challenges, technological preferences, and pedagogical approaches to ensure data saturation.

A total of seven EFL writing instructors were interviewed and responded to survey questionnaires. Participants were selected based on teaching experience, institutional affiliation,

and engagement with digital tools. All interviewees aligned with the initial selection map: experienced EFL writing teachers academically and pedagogically, with at least moderate skills in using digital tools. Table 2 provides an overview of the interviewees.

Table 3.2 Teacher Participants

Name (Pseudonym)	Gender	Degree	University	Teaching Experience	Digital Tool Usage
Cao	F	M.A.	SWMU	8 years	Moderate
Huang	M	Ph.D	CNU	10+ years	High
Sun	F	Ph.D	ZJU	20+ years	Moderate
Wang	F	Ph.D	PKU	10+ years	Low
Zhang	F	Ph.D	PKU	3 years	High
Zhao	M	Ph.D	NIT	15+ years	Moderate
Zhu	F	ED	NENU	10+ years	High

To maintain participant anonymity, pseudonyms were assigned. The range of teaching experience and technology usage among participants ensures a comprehensive understanding of how digital tools are integrated into EFL writing instruction. Although recruitment challenges limited the sample size, the intentional selection of diverse institutions and instructors compensates for these constraints, ensuring that the findings reflect various technological experiences in writing pedagogy.

Data Collection

The data collection instruments consist of a background questionnaire and a semi-structured interview. To examine the degree to which participants integrate different areas of technology-related knowledge in teaching, a self-report questionnaire was developed based on Bostancioglu and Handley's (2018) design for assessing TPACK for English language teaching, which is validated in the EFL context. Figure 1 shows an example of the questionnaire.

Demographic/Background Information

Q1. What is your gender?

- Male
- Female ✓
- Choose not to say
- Other

Q2. What type is your institution?

- Comprehensive ✓
- Language specialized

Q3. What is the highest degree you have earned?

- B.A.
- M.A.
- Ph.D. or ED ✓

Q4. How many years have you taught?

- <1y
- 1-5y
- 6-10y
- >10y ✓

Q5. Are your students predominantly English majors?

- Yes ✓
- No

Q6. What level of education is your students receiving?

- Undergraduate ✓
- Graduate

Q7. Do you have experience teaching online before the pandemic?

- Yes ✓
- No

Technological Knowledge

Q8. I know how to solve my own technical problems

- Yes
- No
- Not sure ✓

Q9. I can learn how to use technology easily

- Yes
- No
- Not sure ✓

Q10. I keep up with new technologies

- Yes ✓
- No
- Not sure

Q11. I know how to use computer-mediated communication (CMC) technologies (e.g. email, chat)

- Yes ✓
- No
- Not sure

Q12. I know how to use web 2.0 technologies (e.g. blogs, social networks, and wikis)

- Yes ✓
- No
- Not sure

Q13. I know how to use multimedia (e.g., graphics, texts, audio, and video)

- Yes ✓
- No
- Not sure

Q14. I know how to use online learning environments (e.g., Zoom, Tencent Classroom)

- Yes ✓
- No
- Not sure

Q15. I know how to use mobile technologies (e.g., tablet computing, smartphones)

- Yes ✓
- No
- Not sure

Technological Content Knowledge

Q16. I know about technologies that I can use to teach writing in English

- Yes ✓
- No
- Not sure

Technological Pedagogical Knowledge

Q17. I can choose technologies that enhance the teaching approaches for a lesson

- Yes ✓
- No
- Not sure

Q18. I can adapt the use of the technologies that I am learning about to different teaching activities

- Yes ✓
- No
- Not sure

Q19. I can design relevant learning experiences to promote student learning, using technology

- Yes ✓
- No
- Not sure

Technological Pedagogical and Content Knowledge

Q20. I can teach lessons that appropriately combine English linguistic concepts, technologies, and teaching approaches

- Yes
- No
- Not sure ✓

Q21. I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn

- Yes
- No
- Not sure ✓

Q22. I can participate in digital learning communities to explore creative applications of technology to improve student learning

- Yes ✓
- No

Figure 3.1 Questionnaire on Digital Usage of the Participants

The following table shows the digital usage level of the interviewees, summarized from the questionnaires:

Table 3.3 *Digital Tool Usage Levels of the Participants*

Participant	TK (Q8-Q15)	TCK (Q16)	TPK (Q17-Q19)	TPACK (Q20-Q22)	Overall Result	Digital Tool Usage
Cao (SWMU)	3	1	1	1	1.5	Moderate
Huang (CNU)	3	3	3	3	3	High
Sun (ZJU)	3	3	2	1	2	Moderate
Wang (PKU)	1	1	1	1	1	Low
Zhang (PKU)	3	3	3	3	3	High
Zhao (NIT)	3	2	2	2	2	Moderate
Zhu (NENU)	3	2	3	3	2.5	High

Interviews were the primary method for collecting in-depth qualitative data. The questions were adapted from Hall (2021), who examined teacher perceptions of self-efficacy and technology adoption in a pandemic context. Interviews focused on: 1) current technology use in writing instruction; 2) perceived benefits and challenges of digital tools; 3) experiences of online teaching during the pandemic; and 4) views on GenAI adoption in writing pedagogy.

Each interview lasted 60-100 minutes and was conducted via Tencent Meeting or WeChat Voice Calls, depending on participant preference. The interviews were audio-recorded with consent and transcribed verbatim for thematic analysis. Figure 2 is the outline of interview questions.

Background Information

Q0. Please briefly describe the course you are teaching.

- a) Is it for English majors or non-English majors?
- b) Is it for writing instruction only or a comprehensive English course where writing is only part of it?

- c) What is the class size?
- d) How long and how often is the class held?
- e) What is the class size?
- f) What is the gender composition of the class?

Context of class

Q1. What practice do you typically use when teaching writing?

- a) What do you usually do to teach writing strategies? (e.g., explaining writing skills, analyzing writing samples, etc.)
- b) What do you usually do to interact with students? (e.g., asking questions, assigning in-class writing tasks, pair work/group collaboration, flipped class, etc.)
- c) What do you usually do to evaluate students' performance (e.g., giving tests, grading writing assignments, peer review and reports, etc.)

Goal of teaching

Q2. What are the main goals of teaching writing in your class?

- a) Is teaching writing mainly for passing the course?
- b) Is it mainly for passing the relevant English credentials (College English Text/CET; Test for English Majors/TEM; Public English Test System/PETs)?
- c) Is it mainly for improving students' writing skills to prepare them for future studies or careers?

Pedagogical Tools and Strategies

Q3. Let's talk about the changes in writing instruction since the pandemic.

- a) How about online teaching during the pandemic?
 - i) What platform did you use for online teaching since the pandemic?
 - ii) Compared with the traditional teaching practices we discussed before, are there any differences in pedagogies you applied in online writing compared to traditional practices? (e.g., more/less interaction with students online; more/less in-class writing practices; more/less students' collaboration ...)
- b) Is online teaching still adopted?
 - i) If yes, what platform did you use for online teaching since the pandemic?
 - ii) If yes, are there any differences in pedagogies you applied in online writing compared to your practices during the pandemic?
- c) Is online teaching conducted before the pandemic?
 - i) If yes, what platform did you use for online teaching before the pandemic?
 - ii) If yes, are there any differences in pedagogies you applied in online writing compared to traditional practices before the pandemic?
- d) In your opinion, what is the most significant change in writing instruction since the pandemic?

Q4. What tools or strategies have you adopted in online teaching?

- a) Among those tools and strategies, what do you believe are effective in improving the quality of writing instruction?
- b) What is the most effective one you believe?

Perceptions of Online vs. Face-to-Face Instruction

Q5. In your opinion, what are the major differences between the traditional face-to-face mode and online education?

- a) Engagement
 - i) What difference do you see in students' engagement between online and traditional

- face-to-face instruction?
- ii) What difference do you see in your engagement between online and traditional face-to-face instruction?
- b) Performance
 - i) What difference do you see in students' writing performance between online and traditional face-to-face instruction?
 - ii) What difference do you see in teachers' instruction performance between online and traditional face-to-face instruction?
- c) Satisfaction
 - i) What difference do you see in students' satisfaction between online and traditional face-to-face instruction?
 - ii) What difference do you see in your satisfaction between online and traditional face-to-face instruction?

Opportunities & Benefits

Q6. In your opinion, what are the benefits or opportunities you believe online writing instruction will bring:

- a) to your students?
- b) to you?
- c) to EFL writing pedagogy?

Difficulties or challenges

Q7. In your opinion, what are the main difficulties or challenges you've experienced in teaching writing online since the pandemic?

Q8. In your opinion, what support could have been provided to help you deliver writing instruction online since the pandemic?

Q9. Did you receive any support to address these difficulties or challenges?

New trend in English Writing Instruction

Q10. Have you adopted any GenAI tools in your writing practices (e.g. writing academic papers, administrative reports, etc.)?

- a) If yes, what tools do you use, and how often do you use them?
- b) Do you get any training? How do you get it?
- c) How do you perceive your user experience?
- d) If not, do you plan to use any in the future?

Q11. Have you adopted any GenAI tools in writing instruction?

- a) If yes, what tools do you use, and how often do you use them?
- b) How do you perceive the use of GenAI tools in supporting writing instruction?
- c) If not, do you plan to use any in the future?

Q12. Have you found that your students use GenAI tools themselves for writing?

- a) If yes, how did you make a judgment, and how did you deal with it?
- b) How do you perceive the contradiction of students' use of GenAI tools? Do you think it will mainly help students write or cheat?

Q13. Is there any other information you would like to share related to this topic?

Figure 3.2 Planned Interview Questions

Data Analysis

This study employed a reflexive thematic analysis approach (Braun & Clarke, 2006; 2019) to interpret the qualitative data collected from semi-structured interviews with university EFL writing instructors. Thematic analysis was chosen for its flexibility in capturing complex experiential patterns and contextual meanings within qualitative data, particularly in applied education research (Xu & Zammit, 2020).

Following Braun and Clarke's (2006) six-phase process, the analysis progressed through the following stages:

Familiarization with the Data. All interviews were transcribed verbatim and read repeatedly by the researcher to gain familiarity with the data. Preliminary notes were taken regarding emerging ideas, recurrent concerns, and unique expressions related to digital tool use, instructional adaptation, and AI integration. This stage helped form an intuitive sense of key patterns and differences across participants and institutional contexts.

Generating Initial Codes. The data were coded following a hybrid thematic approach (Fereday & Muir-Cochrane, 2006). The deductive coding framework was initially guided by key constructs identified in the literature on technology use in language teaching, such as "instructional support tools," "peer review facilitation," and "student engagement" (Bostancıoğlu & Handley, 2018; Putri, 2023). Simultaneously, inductive codes were developed based on data patterns emerging organically from teacher narratives.

All interview transcripts were imported into NVivo. 57 parent and child nodes were created, reflecting the key dimensions of teachers' perceptions, technological challenges, pedagogical shifts, and future directions. The nodes captured multi-layered experiences such as "automated feedback," "blended learning," "lack of technical support," "gamification," "AI for students' writing," and "institutional policy concerns."

Searching for Themes. Once the data were systematically coded, related codes were grouped into broader semantic ones. For example, codes like "Pigaiwang", "Peerceptiv", and

“WeChat feedback” were collated under a broader theme labeled “Integration of Technology in Writing Instruction.” Finally, three overarching themes were generated to address the research questions:

- 1) The Integration of Technology in Writing Instruction;
- 2) Teachers’ Adaptation and Changing Perceptions of Online Writing Instruction; and
- 3) The Future of Hybrid Teaching and GenAI in Writing Pedagogy.

Each theme contained multiple subthemes (e.g., “Facilitating Feedback,” “Psychological Challenges,” “AI for Brainstorming”), supported by corresponding descriptions and excerpts from interview transcripts.

Reviewing Themes. Themes were then reviewed against the full dataset to ensure internal coherence and external distinctiveness (Braun & Clarke, 2006). Overlapping categories were refined and clarified, while less prominent codes were kept to preserve data saturation. Thematic maps were created to visualize the hierarchy and relationships between themes.

Thematic maps were created to visualize the structure and relationships between themes. At this stage, two peer researchers were consulted for validation, ensuring that the identified themes aligned well with the research focus and participant voices (Nowell et al., 2017).

Defining and Naming Themes. The final theme titles were developed to reflect the pedagogical and experiential essence of technology-supported writing and writing instruction. For instance, “The Future of Hybrid Teaching and GenAI” captured teachers’ speculative, reflective, and sometimes skeptical attitudes toward the long-term use of GenAI in EFL writing instruction. Meanwhile, subthemes were generated to ensure clarity and traceability of coded data across interviews and institutional contexts.

Producing the Report. The finalized themes were developed into detailed analytic narratives presented in the Findings. Direct quotations were used to illustrate thematic categories, contextual variation, and cross-case perspectives (Clarke & Braun, 2014). The data

analysis process enabled an in-depth understanding of how EFL writing instructors in China perceive and respond to technological change in their pedagogical practices. The methodology also allowed nuanced insight into the evolving role of AI and institutional support in shaping technology-mediated writing instruction.

Findings

Building on the literature and framed by the TPACK framework, this study explores how Chinese university EFL writing instructors perceive and adopt digital tools in writing instruction. Thematic analysis of interview and questionnaire data revealed three central themes. First, instructors varied in how they integrated digital platforms, with decisions influenced by institutional context, individual TPACK levels, and pedagogical goals. Second, the shift to online teaching during the COVID-19 pandemic prompted both broader tool adoption and reevaluation of teaching practices—some of which were sustained post-pandemic, while others reverted to traditional methods. Third, awareness of GenAI tools was widespread among interviewees. However, direct access to foreign products such as ChatGPT is restricted in mainland China, prompting instructors to either use VPNs or turn to domestic large language models (LLMs) such as Wenxin Yiyan and Doubao. For these local counterparts, adoption was shaped less by access than by institutional policy clarity and pedagogical fit. Across all themes, teachers' perceptions of students' engagement and learning needs shaped their instructional choices, reflecting the role of Pedagogical Content Knowledge. The following themes address the first research question.

Theme 1: Integration of Technology in Writing Instruction

Technology has become an essential part of EFL writing instruction, particularly after the pandemic. Since many digital tools were initially used to facilitate remote teaching, they now play a more lasting role in writing pedagogy. Instructors have adopted various technologies, including automated writing support systems (e.g., Pigaiwang, iWrite, Peerceptiv), instructional support tools (e.g., MOOCs, DingTalk, MKTang), and online teaching platforms (e.g., Tencent

Meeting, ClassIn, DingTalk). These tools have diversified teaching methods, expanded learning accessibility, and streamlined feedback and revision processes. However, challenges remain, such as limited student engagement, difficulties in structuring online activities, and the financial burden of digital tool adoption. Table 4 shows the general information on technology adoption in EFL writing and writing instruction from the interviews.

Table 3.4 Technology Adoption in EFL Writing and Writing Instruction

Participant	Support Tools for Writing & Instruction	Online Teaching Platforms	AI Tools
Cao (SWMU)	Pigaiwang, QQ, WeChat, video recording	Tencent Meeting	ChatGPT, DeepL
Huang (CNU)	Pigaiwang, QQ, WeChat, video recording	WeChat, Tencent Meeting	Wenxin Yiyan, ChatGPT
Sun (ZJU)	iWrite, MOOC, MKTang, QQ, WeChat, DeepL, video recording	DingTalk, Tencent Meeting	ChatGPT, Wenxin Yiyan, DeepL
Wang (PKU)	WeChat, QQ, video recording tools	Tencent Meeting, Xiaofeiya, Zoom	ChatGPT, Wenxin Yiyan
Zhang (PKU)	Peer feedback checklists, QQ, WeChat, video resources	ClassIn, Tencent Meeting, Zoom, Xiaofeiya	ChatGPT
Zhao (NIT)	Pigaiwang, WeChat, QQ, DingTalk	DingTalk	Wenxin Yiyan, Doubao
Zhu (NENU)	Peerceptiv, QQ, WeChat, email, video recording	DingTalk, Tencent Meeting, Zoom	Zhipuqingyan, Wenxin Yiyan, Kimi

The Role of Digital Tools in Writing Instruction

Writing Support Tools for Students. Automated writing platforms have become widely used to assist students in grammar correction, structured peer review, and self-editing. Among these, Pigaiwang, iWrite, and Peerceptiv are frequently employed to provide immediate feedback on writing assignments. Pigaiwang has been a popular choice for grammar correction and structural suggestions, while iWrite offers automated feedback on coherence and organization.

For peer learning, Peerceptiv structures student review processes, helping them critically assess their own and others' work. These platforms have helped students take a more active

role in their revision process, reducing instructors' grading burden and reinforcing independent writing development.

Instructional Support Tools for Teachers. Beyond automated writing assistance, instructors employ MOOCs, MKTang, and DingTalk to enhance lesson delivery and student engagement. MOOCs and MKTang provide pre-class materials and interactive exercises, allowing students to prepare for in-class writing tasks at their own pace. Dr. Sun (ZJU) explained, "I used MOOC as an additional resource for students to access pre-class materials and reinforce key writing concepts."

Additionally, DingTalk and other digital platforms serve as resource-sharing hubs where instructors can store recorded lessons and supplementary materials. Teachers also rely on communication platforms such as WeChat and QQ for individual writing consultations and quick student feedback.

Online Teaching Platforms for Writing Instruction. Instructors use Tencent Meeting, DingTalk, ClassIn, and Zoom for live writing instruction, as well as university-specific learning management systems (LMS) like Xiaofeiya and CNU/SWMU platforms. ClassIn and Tencent Meeting provide interactive features such as breakout rooms and screen sharing, enabling students to engage in group writing exercises and peer feedback sessions.

Recorded lessons have also become a standard practice, ensuring that students can review writing concepts at their own pace. DingTalk and university LMS platforms store lecture recordings and supplementary materials, allowing for asynchronous learning support. Dr. Zhu (NENU) noted, "DingTalk remains a requirement for storing recorded lessons, ensuring students have continued access to writing instruction."

Benefits of Technology in Writing Instruction. The study shows that integrating digital tools into EFL writing instruction has expanded teaching methods, increased learning accessibility, enriched learning materials, facilitated feedback, and improved students' writing

development. After the adoption of online instruction during the pandemic, many teachers have continued using these technologies due to their pedagogical benefits.

Diversifying Teaching Methods. Teachers reported that technology had allowed diversified instructional methods by incorporating online discussion and communication, multimedia teaching resources, and interactive writing tasks. Digital platforms facilitated peer review, self-paced learning, and collaborative writing activities. Dr. Zhao (NIT) explained, “Before the pandemic, my classes were more lecture-based, but now I integrate structured online discussions and multimedia materials, which give students more ways to engage.” Similarly, Dr. Sun (ZJU) shared, “I’ve continued using online discussions even after returning to in-person teaching because they help structure peer feedback and make students more reflective about their writing.”

Additionally, tools like WeChat and QQ provided additional space for extended discussions and real-time clarification, which was particularly helpful in maintaining communication beyond class hours. Dr. Zhang (PKU) reflected, “WeChat has been invaluable—not just for announcements but for quick writing consultations after class.”

Increasing Accessibility & Flexibility. Online instruction was most widely recognized for greater accessibility to learning materials. Students could review recorded lectures, revisit teacher feedback, and access interactive exercises at their own pace, making the learning process more flexible.

Recorded sessions ensured that students with scheduling conflicts or connectivity issues could keep up with the course. Dr. Wang (PKU) noted, “It (recording lectures) was something I never considered before, but now students tell me how useful it is to go back and review explanations, especially for difficult writing concepts.” Some teachers also extended their consultation hours with tools like Tencent Meeting and WeChat, allowing students to seek help beyond regular class time.

Both synchronous and asynchronous instruction, with the assistance of technologies, allowed teachers to offer more personalized and adaptive support to students across different learning needs.

Enriching Learning Content & Resources. Technology also expanded the range of materials available to students, providing a more engaging and interactive learning experience. Many instructors integrated audio or video resources, digital articles, and annotated model essays into their writing instruction.

Dr. Zhang (PKU) remarked, “Students engage better when they can see and analyze real writing examples, rather than just listening to theoretical explanations.” Similarly, Dr. Wang (PKU) found that “students were more engaged when I used online discussion boards to encourage them to analyze different writing styles before drafting their own work.”

Multimedia content, such as video lessons from well-known scholars or writers, also provided students with additional learning support. Dr. Huang (CNU) said, “Students love those online lectures since the hosts are really experienced and attractive compared with routine classes.”

Facilitating Feedback & Revision. Teachers found that online platforms more efficiently structured the feedback process, particularly for large classes. Automated tools like Pigaiwang and iWrite provided immediate feedback, enabling students to correct surface-level errors before receiving more detailed instructor comments. Dr. Huang (CNU) explained, “Pigaiwang was great for helping students fix grammar and structure on their own. By the time I reviewed their work, they had already made initial improvements.” Similarly, Ms. Cao (SWMU) observed, “I noticed students using Pigaiwang multiple times before submitting, which made their final drafts stronger.”

Moreover, structured peer review conducted on platforms like Peerceptiv allowed students to better engage with their writing. Dr. Zhu (NENU) shared, “Peer review became more meaningful because students were required to give detailed feedback. After evaluating their

classmates' essays, I found they were more critical of their own work.” WeChat and QQ were also widely used for quick feedback loops, allowing students to receive clarification without waiting for the next class session.

Improving Writing Development. Teachers observed noticeable improvements in students' writing skills due to increased exposure to feedback and revision tools. Many students developed stronger self-editing habits, as platforms like Pigaiwang encouraged them to revise their work multiple times before final submission. Ms. Cao (SWMU) emphasized, “Students became more independent in their writing process. They revised more frequently and weren’t just waiting for me to point out their mistakes.”

Some teachers also found that peer feedback activities helped students reflect more critically on their writing. Dr. Wang (PKU) noted, “Those who engaged actively in peer review showed clear improvements in structuring their arguments. They began applying the same critique to their own work.” This suggests that technology-supported feedback processes reinforced revision strategies, ultimately enhancing students’ writing quality over time.

Limitations of Technology in Writing Instruction

While digital tools made writing instruction more efficient, teachers also pointed out several challenges. The most common concerns included reduced student engagement, difficulties organizing class activities, limitations in automated feedback, and the financial burden of using specific tools. All interviewed teachers believed that technologies are helpful, but they couldn’t fully replace the interaction and feedback in traditional classrooms.

Less Student Engagement & Classroom Interaction. Teachers' most prominent challenge was getting students to participate actively in online lessons. Many students remained passive, and teachers felt like they were lecturing into a void. Some described online discussions as one-sided, with little response from students. Dr. Zhao (NIT) shared, “It felt like I was talking to myself most of the time. In a physical classroom, I can see their expressions and tell if they’re confused, but online, they just stay quiet.” Teachers also noticed that students

seemed less motivated in an online setting. Without face-to-face interaction, it was harder to keep them engaged. Dr. Huang (CNU) commented, “In a classroom, I can walk around, check their progress, and encourage them. Online, some students just sat there, and I had no idea if they were paying attention.”

Beyond engagement, teachers found that the lack of spontaneous discussion made writing instruction feel less dynamic. Dr. Wang (PKU) observed, “Writing is a process that benefits from real-time feedback and discussion, but online, students were hesitant to ask questions or discuss their ideas.”

Difficulties in Organizing Class Activities. Teachers found it difficult to structure peer review and collaborative writing tasks in an online teaching mode. While tools like Peerceptiv and iWrite provided ways for students to give feedback, some instructors felt these platforms lacked accountability compared with traditional in-class activities. Dr. Huang (CNU) explained, “In class, I can walk around and see who is actually reviewing their partner’s work. Online, I had to just trust that they (students) were doing it properly, but to be honest, I am not sure.”

Some students also found it more challenging to work together remotely. Without the ability to have quick, informal discussions, collaboration became less natural. Ms. Zhu (NENU) mentioned, “Group work was harder because students weren’t as willing to communicate outside of class. In person, they can just turn to each other, but online, they avoided messaging each other unless I specifically required it.”

Shallow Automated Feedback & Limited Writing Development. While platforms like Pigaiwang and iWrite were helpful for grammar and structure, teachers felt that they weren’t enough to support in-depth writing skills. Dr. Zhang (PKU) pointed out, “Pigaiwang finds grammar mistakes quickly, but it doesn’t help students develop their ideas or structure their arguments better. They still need comments from teachers.”

Some teachers also worried that students relied too much on automated corrections without fully understanding them. Dr. Zhao (NIT) explained, “I noticed some students just accepted all the suggested changes without thinking.”

Cost of Digital Tools & Institutional Budget Constraints. The application of technology requires financial support from institutions. However, many universities and institutions provided no extra funding for technological use. Dr. Sun (ZJU) explained, “We didn’t get funding for extra online platforms, so I switched from MOOC to MKTang, a Chinese version of MOOC. It is not as good as MOOC, but it is accessible and free to me and my students.”

On the other hand, some universities invested in paid platforms, allowing teachers to use advanced features for writing instruction. Ms. Cao (SWMU) shared, “Our school supported Peerceptiv, which required payment, but it was worth it because students could do structured peer reviews. Without funding, I wouldn’t have considered it.”

Unbalanced tech-related funding across institutions resulted in unequal access to digital resources. Some teachers could not use specific tools or platforms in instruction due to the cost, while others benefited from fully funded tools that enhanced writing instruction.

Theme 2: Teachers' Adaptation and Changing Perceptions of Online Writing Instruction Since COVID-19

The abrupt shift to online teaching required EFL instructors to modify their pedagogical strategies, incorporate new digital tools, and develop engagement techniques. Some teachers had prior experience with technology in writing instruction, while others faced more challenges in using tools for online teaching. Over time, all the interviewed teachers were more comfortable with digital platforms. The transition to online learning also influenced teachers’ perceptions of the use of technology. They found benefits of flexibility and accessibility in using digital tools, but were also constrained by reduced classroom interaction and increased workload. Institutional support, including training and infrastructure improvements, plays a crucial role in the adaptation process.

Teachers' Adaptation to Online Writing Instruction

Pre-Pandemic Use of Technology in Writing Instruction. Before the pandemic, technology played a supplementary role in EFL writing instruction, primarily supporting students' autonomous learning rather than serving as a central instructional tool. Some teachers had already integrated MOOC and MKTang for writing exercises and additional practice materials. As Dr. Sun (ZJU) noted, "I used MKTang as an extension of my in-class activities, but my main instruction was face-to-face." Similarly, Pigaiwang, an automated feedback system, was widely used for writing assignments. Dr. Huang (CNU) emphasized its benefits, stating, "Students submitted their essays to Pigaiwang, and I provided additional comments to refine their writing." However, synchronous online teaching tools, such as Tencent Meeting, DingTalk, and Zoom, were rarely utilized for live instruction before the pandemic.

Rapid Adoption of Online Teaching Platforms. With the sudden shift to remote instruction, teachers had to quickly adapt to delivering lessons using online platforms such as Tencent Meeting, DingTalk, ClassIn, and Zoom. However, this transition was not easy. Some universities mandated the use of specific platforms, but teachers had to navigate technical constraints on their own. Dr. Zhu (NENU) recalled, "DingTalk was the required platform at my university. But its limitations, such as restricting student participation, pushed me to try other tools like Tencent Meeting for better interaction." Similarly, Dr. Zhang (PKU) shared, "I primarily used ClassIn, but sometimes had to switch to Zoom or Tencent Meeting due to connectivity issues."

Teachers also faced technical challenges as they hadn't used these platforms before. Some instructors struggled with complicated interfaces, while others found it time-consuming to master multiple digital tools. Dr. Zhang (PKU) noted, "ClassIn had useful features like breakout rooms, but some colleagues, especially senior ones, found it too complex." For students who learned at home during the pandemic, challenges in the transition were mainly due to technical issues. Those from rural areas or lower-income backgrounds experienced unstable internet

connections, which disrupted their participation in writing courses. Dr. Wang (PKU) observed, “Online learning worked well for those with good access, but for some students, just staying connected was a problem.” Despite these challenges, teachers gradually adjusted to online platforms and became used to combining multiple tools to deliver lectures.

Adjustments in Teaching and Engagement Strategies. One of the biggest challenges teachers faced during online instruction was maintaining student participation and engagement. Many students were reluctant to turn on their cameras, remained silent in discussions, or disengaged from collaborative tasks. Dr. Huang (CNU) shared, “Online classes often felt like one-sided lectures. Without physical interaction, I didn’t know whether students were truly engaged or just keeping the meeting window open.” Similarly, Dr. Zhao (NIT) noted, “Students were less willing to speak up online. It was difficult to have meaningful discussions.”

To address these issues, teachers tried innovative strategies to make online writing instruction more interactive. Some adopted a more question-driven approach. For instance, they kept asking questions in class and added breakout room discussions and real-time polls. Some instructors tried gamification techniques to sustain students' focus. They designed short quizzes, competitive activities, and interactive games to keep students refreshed.

Moreover, some instructors developed detailed peer review guidelines to help students provide constructive feedback to each other. Dr. Zhang (PKU) explained, “I developed special checklists for online peer review, which could guide students to focus on thesis structure and personal statements rather than just grammar corrections.”

Psychological and Workload Adjustments for Teachers. The shift to online instruction presented significant psychological and workload challenges for many instructors. The lack of students' physical presence and class observation made it difficult for teachers to engage with students during online instruction, leading to isolation. Dr. Huang (CNU) described the situation and expressed frustration over one-sided lectures: “It (online teaching) often felt like delivering a

monologue. Many students remained passive, and I had to come up with ways to constantly get them involved.”

Instructors also faced an increased workload, as preparing online lessons required additional effort in designing online lessons or recording lectures, thinking of interactive tasks, and providing more written feedback to maintain the teaching effect and quality. Dr. Wang (PKU) stated, “I spent significantly more time preparing lessons because I had to anticipate student difficulties and provide detailed guidance in advance.”

Perceived Benefits of Online Writing Instruction. The shift to online instruction was difficult. However, many teachers saw the benefits of technology adoption to their work and life, especially in terms of time savings, flexibility, and convenience. Online instruction was more convenient for teachers in course planning and delivery. They could effectively arrange resources with the use of digital materials and lectures that had already been recorded. “It was easier to prepare everything in advance and ensure students had access at any time,” said Dr. Zhu of NENU. “I didn’t have to worry about printing materials,” noted Dr. Zhao of NIT, “Everything was posted on the internet.”

Instructors valued the flexibility in providing consultations and office hours, which let students ask for assistance outside of scheduled class times. “I had more freedom to set office hours, even in the evenings, so students had more opportunities to ask for guidance,” Dr. Zhang (PKU) remarked.

By cutting down on commute time, teachers were able to devote more time to class planning and student feedback. “Not having to commute meant I had extra time to provide detailed feedback on student writing,” said Dr. Sun (ZJU).

Teachers’ Perceptions of Students’ Adaptation to Online Learning. Students had mixed experiences with online writing instruction. While some appreciated the flexibility and accessibility of digital tools, others struggled with engagement, motivation, and the lack of direct

interaction with teachers and peers. Their adaptation largely depended on individual learning styles, self-discipline, and access to reliable technology.

Positive Adaptations. For some students, online learning provided greater flexibility in managing their studies. Revisiting recorded lectures and completing assignments at their own pace helped those who needed more time to learn. Dr. Zhu (NENU) pointed out, “It (remote learning) provided flexibility for those who had personal issues like health problems during the Pandemic or other scheduling conflicts to attend the class.” Remote instruction was especially beneficial for students trying to balance coursework with other responsibilities during the pandemic.

Some students also felt more comfortable participating in online discussions through chatbox than speaking out. Online platforms allowed them to contribute in written forms, making engagement easier for those who were usually hesitant to speak in traditional classroom settings. Dr. Zhang (PKU) noted, “Students who were too shy to speak in person were more willing to participate in chat-based discussions.”

In addition, automated writing tools such as Pigaiwang and iWrite enabled students to take more responsibility for revising their own work. With immediate feedback, students could refine their grammar and structure before submitting assignments, improving their self-efficacy and writing performance.

Challenges & Negative Perceptions. Despite these benefits, many students found online learning less engaging than face-to-face instruction. Many felt isolated and disconnected from their instructors and peers, negatively affecting their motivation. As Dr. Zhu (NENU) described, “In traditional classes, students were more engaged. They were more willing to ask questions and were more active in participating in discussions.” Online instruction made it harder for some students to stay focused and actively participate. Technical difficulties worsen these challenges. Poor internet connection, particularly for students in rural areas, disrupted their learning.

Moreover, most students perceived online learning as more passive than traditional. The digital platforms generated one-way communication, making discussions feel forced rather than spontaneous. Dr. Zhang (PKU) noted, “Students often hesitate to speak up. Many turned off the camera and muted themselves from the beginning to the end, even as I required them to participate.” Under the online mode, the reduced sense of classroom dynamics and peer collaboration made learning less appealing to many students. Notably, it made students with less self-discipline to slip away since there was no physical monitoring and reminding from their teachers.

As a result, most students preferred returning to in-person instruction, where they could engage in face-to-face discussions and receive immediate feedback from the teacher or peers.

Teachers’ Perceptions of Institutional Adaptation. The transition to online education was shaped by individual teachers and students as well as by broader institutional responses. Universities play a critical role in facilitating digital instruction, but their policies and support structures varied widely, affecting the overall effectiveness of the transition.

Institutional Adaptations During the Pandemic. At the onset of the pandemic, universities rapidly implemented emergency remote teaching strategies, requiring faculty to transition to online platforms such as DingTalk, Tencent Meeting, and ClassIn. However, institutional investment in digital infrastructure varied. Some universities provided substantial resources and support, while others left teachers to navigate the transition independently. Dr. Zhao (NIT) remarked, “The university mandated the use of DingTalk, but beyond that, we had to figure things out ourselves.”

Certain institutions also introduced new digital tools to support writing instruction, including automated feedback systems such as Peerceptiv and iWrite. Ms. Cao (SWMU) noted, “We adopted iWrite to help students receive automated feedback, but there was little guidance on how to integrate it into our teaching.” This lack of systematic implementation highlights the uneven digital preparedness across institutions.

Teacher Training & Professional Development. One of the most significant institutional gaps during the transition was the lack of structured training for online instruction. Most teachers had to learn how to use new platforms independently, with minimal professional development opportunities provided by their universities. Dr. Huang (CNU) commented, “There were no formal training sessions—we had to experiment and teach ourselves how to use online tools effectively.”

As a result, many educators expressed a strong demand for ongoing training in digital pedagogy, including how to integrate AI tools and online writing platforms more effectively. Dr. Zhang (PKU) emphasized, “If online instruction is here to stay, universities must provide structured training on how to use digital tools meaningfully rather than just as emergency measures.”

Addressing Technological Barriers. *In response to the challenges of online instruction, universities made significant efforts to enhance their digital infrastructure and technological support. Many institutions upgraded their servers and expanded data bandwidth to accommodate the demand for live classes and digital learning activities. Some institutions also invested in more reliable cloud-based platforms for storing recorded lectures and managing course materials to provide better accessibility.*

Beyond infrastructure upgrades, universities expanded their technical support teams to assist faculty with platform issues and digital tool applications. Ms. Cao (SWMU) observed, “Technical difficulties, such as unstable internet connections or unfamiliarity with online tools, were major issues at the start of the pandemic, but over time, universities strengthened their support systems to help mitigate these problems.” These institutional adaptations played a crucial role in providing online and hybrid instruction, though the extent of technological improvement varied among universities.

Theme 3: The Future of Hybrid Teaching and GenAI in Writing Pedagogy

The shift to hybrid teaching models has had a lasting impact on writing instruction. Recorded lectures, digital tools, and online collaboration have become standard practice. With the rapid development of Generative Artificial Intelligence (GenAI) technology, the role of AI tools in writing instruction remains uncertain. Instructors have explored GenAI tools (e.g., ChatGPT, Wenxinyiyan, Doubao, Kimi) for personal academic tasks. However, the integration of GenAI into teaching is still limited due to their concerns over academic integrity, over-reliance, and a lack of professional training and guidelines. Future integration of GenAI in writing pedagogy will depend on institutional regulations, ethical considerations, and structured teacher training to ensure it complements rather than replaces traditional writing instruction.

The Lasting Role of Hybrid Teaching in Writing Instruction. The shift to online instruction during the pandemic has led to permanent changes in how EFL writing is taught. All universities in this study have formally adopted a hybrid teaching model, requiring instructors to record and post their lectures online for students to review. In addition to the institutional requirement, many teachers choose to use digital tools to enhance writing instruction.

Teachers noted that recorded lectures have become a valuable component of their courses, allowing students to revisit complex writing concepts at their own pace. Besides recorded lectures, many instructors have retained digital tools and platforms in writing instruction. Before the pandemic, tools like Pigaiwang, iWrite, and Peerceptiv were mainly used for after-class assignments, allowing students to receive automated feedback and revise their work independently. However, these tools became essential for writing instruction during the transition to online teaching. In the hybrid teaching model, instructors have further integrated them into classroom activities, using them to facilitate peer collaboration and in-class exercises. Dr. Zhao (NIT) shared, “I now use Pigaiwang for in-class peer review, where students first receive automated feedback before discussing in small groups.”

Teachers also continue to use live conferencing platforms such as Tencent Meeting, DingTalk, and ClassIn, particularly for writing consultations and peer collaboration. Some instructors find that these platforms allow them to offer additional writing support, making teaching and interaction more accessible to students. Dr. Zhang (PKU) shared, “Platforms like DingTalk and Tencent Meeting allow me to provide writing feedback and answer their questions more flexibly. Before the pandemic, students needed to book office hours and come to my office based on the planned schedule.”

However, while digital tools have enhanced instructional flexibility, their long-term role in writing pedagogy remains uncertain. Some universities have actively supported digital integration, while others have left hybrid elements up to individual instructors. Teachers are worried that without standardized policies, hybrid teaching remains unevenly implemented, and its future depends largely on institutional priorities and teacher training.

Despite these uncertainties, many instructors agree that digital tools will shape writing instruction in various ways. As Dr. Sun (ZJU) stated, “Before the pandemic, I didn’t use online platforms for writing instruction. Now, they are an essential part of my teaching.”

The Role of GenAI in Future Writing Instruction. The adoption of GenAI in Chinese EFL writing instruction is limited and exploratory. Most instructors have not formally incorporated GenAI tools into their teaching due to the lack of professional training, clear guidelines, and institutional policies. Still, they tried these tools, such as ChatGPT or its Chinese counterparts (Doubao, Wenxinyiyan, and Kimi), for personal academic tasks such as language refinement, brainstorming for paper writing, and revision feedback.

Teachers’ attitudes toward GenAI vary, with some recognizing its efficiency and accessibility and others expressing concerns. Most teachers doubted GenAI tools due to potential negative consequences on academic integrity, over-reliance on technology, and their limitations in providing deep writing feedback. As GenAI continues to evolve, its role in writing

instruction will depend on how institutions, educators, and students navigate its benefits and challenges.

Early Adoption of GenAI: Personal and Limited Instructional Use. As GenAI tools rapidly evolve, universities have become early adopters in exploring their potential in academic settings. Despite accessibility constraints in China, many EFL instructors have experimented with ChatGPT and domestic alternatives like Wenxinyiyan, Doubao, and Kimi for their scholarly work. However, the lack of formal training, institutional policies, and academic discussions has caused teachers to explore GenAI on their own, primarily for personal writing tasks and limited instructional use.

Most teachers first used GenAI tools for personal academic writing, editing, and research assistance. They found these tools helpful for language refinement, text structuring, and brainstorming research topics. Dr. Huang (CNU) shared, “I use GenAI tools to polish my writing, especially when working on academic papers and proposals.” Similarly, Dr. Wang (PKU) reported using ChatGPT to generate summaries and analyze argument structures, explaining, “It helps me quickly organize ideas, but I still have to refine the logic myself.”

Teachers also compared different AI models to assess their strengths. ChatGPT was widely recognized for its fluency and versatility, while Chinese GenAI models were more effective for administrative writing in Mandarin. Ms. Cao (SWMU) observed, “Wenxinyiyan works well for official documents, but it’s not as strong in generating complex English academic writing.” However, since ChatGPT remains restricted in China, many teachers rely on VPN access or domestic platforms, limiting their exposure to the full capabilities of foreign-developed AI tools.

Although GenAI tools were widely used for personal academic work, a few instructors experimented with integrating them into teaching. These attempts were mainly focused on helping students refine their writing rather than fully incorporating AI into lesson structures.

Ms. Cao (SWMU) introduced ChatGPT-generated writing prompts and sample essays to illustrate different writing techniques. He explained, “I use GenAI tools to generate examples, which students analyze and improve, helping them understand the revision process better.”

Meanwhile, Dr. Huang (CNU) compared AI-generated essays with student submissions, encouraging discussions about coherence, argumentation, and stylistic differences. Some teachers preferred AI translation tools for grammatical accuracy and sentence improvement. Dr. Sun (ZJU) noted, “I use DeepL to help students better understand English usage and improve their sentence structure by providing translation and revision assistance.” These applications helped streamline revision processes and improve textual clarity. Other instructors incorporated GenAI into peer feedback activities. Dr. Zhu (NENU) noted that AI-generated feedback helped students identify areas for revision, though she emphasized that human input remained essential.

Despite these innovations, teachers' concerns about academic integrity and the lack of clear guidelines have prevented GenAI tools from broader adoption. Some teachers suspected that students were already using GenAI for text generation. With limited institutional support and guidance, most instructors remained cautious about integrating GenAI into formal instruction or pedagogical means. They believe GenAI should be a supplement rather than a replacement. Dr. Zhang (PKU) expressed concern that introducing GenAI too early might lead to over-reliance, explaining, “Students in the early stages of writing should develop foundational skills before turning to AI-generated suggestions.”

Teachers hold mixed perspectives on GenAI tools. For teachers in the interview, the main advantages of GenAI tools lie in their ability to assist in editing, revision, and idea generation. GenAI can serve for self-editing by helping students refine their drafts, correct grammar, and restructure sentences. Dr. Sun (ZJU) emphasized GenAI tools could help students by suggesting improvements of their writing pieces and streamlining unclear sentences.

Additionally, some teachers noted that GenAI could offer students alternative perspectives on their writing. Dr. Zhu (NENU) explained, “These tools help students identify areas that need improvement and provide initial feedback like peer review.” In this sense, GenAI serves as a scaffold that allows students to identify problems in their writing before receiving instructor feedback.

Furthermore, GenAI’s efficiency in text generation and brainstorming provides students with more ideas for exploring writing structure and writing styles. Dr. Huang (CNU) noted that comparing AI-generated texts with student essays helped learners analyze writing techniques more critically.

Despite welcoming the benefits of GenAI tools, most teachers hesitated to integrate them formally into their instruction due to a lack of training and clear institutional policies. Without proper guidance on the assessment of AI-generated work or the prevention of misuse, instructors remained uncertain about GenAI’s role in writing education. Dr. Zhang (PKU) explained, “I don’t ban its use, but I teach students to use it critically...These tools should support learning, not replace independent thinking.”

Another major challenge is detecting AI-generated assignments. Dr. Sun (ZJU) acknowledged, “I have not observed widespread or obvious use of GenAI tools in student work, but I know they could be using them for paragraph or essay generation.”

Moreover, over-reliance on GenAI is also a main concern. Some teachers worried that students might depend too much on AI suggestions without developing their writing skills. Dr. Zhang (PKU) noted, “For students still developing their writing, relying on these GenAI tools can undermine their learning and writing practice.”

Future Considerations for GenAI in Writing Instruction. As GenAI continues to evolve, its role in EFL writing instruction remains uncertain. Teachers in this study held that the future of GenAI adoption lies in how institutions, educators, and students navigate its benefits and challenges. They emphasized the need for clear policies, ethical considerations, and

structured guidance. Through these measures, GenAI tools could be used to enhance EFL students' English writing skills rather than to replace their learning process and writing practices.

Managing Academic Integrity and Plagiarism. One of the biggest concerns about GenAI adoption is academic integrity. Without clear evaluation policies on AI-assisted writing, teachers struggled to determine when AI use becomes plagiarism. Dr. Wang (PKU) shared, “I encourage students to use GenAI responsibly, but the challenge is distinguishing between appropriate help and complete reliance.”

Some instructors have proposed a more transparent approach, where students disclose their use of AI tools in their assignments. Dr. Huang (CNU) suggested, “If students use AI in their writing assignment, they are required to explain how they used AI in their writing process.” However, institutional backing and standardized evaluation criteria need to be introduced for such transparency.

Balancing AI Assistance and Critical Thinking. Teachers agreed that GenAI should not replace essential writing processes like brainstorming, drafting, and revision. Dr. Zhang (PKU) warned, “If students rely too much on AI-generated text, they might not develop the critical thinking skills essential for writing.” To avoid this, some instructors tried to integrate GenAI in a controlled manner. For example, they allow students to use GenAI tools to check text accuracy and get revision feedback only after drafting.

Ms. Cao (SWMU) has experimented with this approach, encouraging students to use GenAI tools for self-editing exercises while still maintaining a structured writing process. He explained, “I tell students to refine their work first and only use AI for final-stage improvements, so they don’t skip essential steps in writing.”

Institutional Guidelines and Teacher Training. A major challenge in GenAI adoption is the lack of professional training and official guidelines. Teachers noted that without proper institutional support, they are left to figure out AI integration on their own. Dr. Zhu (NENU)

pointed out, “We need formal discussions on how to use GenAI effectively in writing instruction. Right now, everyone is experimenting without a clear framework.”

Some instructors stressed that universities should lead efforts to regulate GenAI use rather than leaving it up to individual teachers. Dr. Zhao (NIT) argued, “If GenAI is becoming a permanent part of writing instruction, schools need to provide structured training for both teachers and students.” This includes establishing best practices for AI integration, developing assessment methods, and setting ethical guidelines.

While some educators remain hesitant, most acknowledge that GenAI adoption is inevitable. The future of AI-assisted writing instruction will likely involve a structured, regulated approach that balances technological advantages with pedagogical integrity. Dr. Huang (CNU) summarized this view: “AI should complement teaching, not replace it. The key is to find ways to integrate it without weakening or damaging the learning process.” Moving forward, educators call for collaborative efforts between universities, policymakers, and researchers to develop responsible AI-use frameworks. They agreed that with proper training and ethical policies, GenAI could become a valuable tool in supporting student learning while maintaining academic integrity.

Discussion and Limitations

This study examines how Chinese university EFL writing instructors perceive and incorporate digital technologies into their writing instruction. The findings revealed notable differences across institutional tiers, individual TPACK levels, and regional socioeconomic conditions. These variations influenced not only the implementation of digital tools but also how instructors evaluated their pedagogical value. While the study offers meaningful insights into the contextual factors shaping technology use in EFL writing, it has several limitations, particularly regarding sample scope, data sources, and generalizability. These limitations provide a critical context for interpreting the findings and suggest directions for future research.

Institutional Context and TPACK Variation

Participants' adoption of technology and its integration in instructional integration varied significantly depending on the tier and location of their institutions. Teachers from top-tier universities such as PKU and ZJU had access to more stable infrastructure and broader exposure to global digital platforms, yet differences still emerged at the individual level. For instance, although both teachers from PKU had access to similar tools, one showed high TPACK integration while the other reported low confidence and usage. In contrast, second-tier universities in less economically developed regions, such as SWMU and NENU, exhibited moderate to high engagement with tools despite fewer resources. Institutional support, both in terms of funding and training, was a consistent factor shaping these differences.

The differences across TPACK levels, as revealed in the questionnaire results, further suggest that strong content and pedagogical knowledge do not automatically lead to effective digital integration. Interviewees with high TPACK competence aligned tools with instructional goals, implemented AI-enhanced feedback loops, and structured peer reviews using platforms like Peerceptiv and Pigaiwang. Others, despite being pedagogically experienced, lacked the technological knowledge to use tools beyond administrative purposes.

These findings are consistent with earlier research suggesting that institutional tier, regional development, and school-level leadership play a crucial role in enabling or constraining technology use in higher education (Canals & Al-Rawashdeh, 2019; Liang, 2021). Although Chinese EFL instructors are increasingly encouraged to adopt digital tools, even within well-resourced institutions, disparities in TPACK implementation can arise due to individual differences in training, confidence, and pedagogical orientation. At the same time, data from interviews and surveys raise questions about how institutional structures might be adjusted to better support differentiated teacher needs. Rather than assuming that higher-tier institutions automatically ensure more effective integration, the findings point to the importance of localized and teacher-centered initiatives. It may be useful for institutions to explore how training models

could be better aligned with the specific instructional demands of writing pedagogy and how peer collaboration might be cultivated as a form of ongoing, practice-based professional learning.

Moreover, the role of institutional culture appears worthy of further attention. Teachers in less-resourced universities, when supported by responsive local leadership or a collaborative departmental environment, sometimes demonstrated more active and reflective use of technology. This suggests that future strategies might benefit from focusing not only on expanding access to tools but also on fostering environments where experimentation, feedback, and pedagogical alignment are supported.

Digital Tools and Higher-Order Thinking

An important finding of the study was how tools could support students' engagement with higher-order writing skills. Instructors who leveraged platforms for structured peer review, revision guidance, and genre analysis enabled students to go beyond surface-level correction. For example, Peerceptiv encouraged students to reflect on the organization and quality of their arguments, while AI-generated model texts facilitated discussions about rhetorical structures and coherence. This reflected the influence of teachers' Pedagogical Content Knowledge (PCK), especially their understanding of how students respond to various forms of instructional feedback was necessary to help them internalize writing strategies. Where teachers anticipated students' needs and embedded tools within instruction, students' engagement deepened. On the contrary, where tools were introduced without structure, students tended to rely on surface-level correction or skip critical revision steps.

This contrast highlighted the potential role of digital tools in supporting higher-order thinking in writing instruction. Under Bloom's (1956) higher-order thinking skills, the study finds that digital tools were more effective in improving EFL students' writing development when applied to assist students in brainstorming ideas, analyzing content and organization, and conducting peer reviews. Another notable finding is that digital tools can facilitate higher-order

thinking when instructional designs explicitly prioritize analytical and evaluative skills, such as Dr. Zhang (PKU)'s development of structured peer-review checklists. Contrary to concerns that integrating AI and automated tools into writing instruction may encourage overreliance and reduce students' independent thinking (Walter, 2024; Cassidy, 2023), this study demonstrates that when digital platforms are embedded within pedagogical strategies grounded in feedback and metacognitive awareness, they can actively support cognitive engagement. For instance, in this study, Peerceptiv enabled students to assess the coherence and logic of peer essays, while teacher-guided analysis of AI-generated model texts prompted classroom discussions around argument quality, rhetorical structure, and genre expectations. These practices, reported by instructors such as Dr. Zhang and Dr. Zhu, reflect the application of Pedagogical Content Knowledge (PCK) in aligning tool use with students' developmental needs.

Such instructional strategies align with Bloom's taxonomy of higher-order thinking, particularly the stages of analysis, evaluation, and creation (Bloom, 1956). This is consistent with Wang and Fan's (2025) meta-analysis, which found that AI tools like ChatGPT, when combined with teacher scaffolding, moderately improved students' ability to evaluate arguments and synthesize ideas in academic writing. Similarly, Du et al. (2025) reported that students engaged in AI-assisted problem solving demonstrated greater use of higher-order strategies—such as organizing claims and assessing alternative viewpoints—compared to control groups. These findings reinforce that the impact of digital tools on thinking skills is highly dependent on how instructors integrate them into instruction, echoing prior research that emphasizes the centrality of teacher design in technology-supported learning (Hyland & Hyland, 2019; Walter, 2024).

Given these observations, the study invites further reflection on how technology integration might evolve beyond serving as an automated correction or evaluation tool. While platforms like Pigaiwang or ChatGPT can help identify mechanical issues, their full educational value may lie in how they are used to prompt critical thinking, comparative writing, and revision

planning. Instructors may experiment with pairing AI-generated feedback with student self-assessment, using peer review platforms to develop audience awareness, or embedding tool use within genre-based instruction. From a pedagogical standpoint, this suggests a shift toward designing tool-supported activities that encourage students not only to fix language errors but to reflect, rethink, and refine their ideas in ways that enhance both cognitive engagement and writing competence.

Underrepresentation of Local GenAI Tools and Gaps in Research

This study revealed that while Chinese EFL writing instructors are increasingly aware of generative AI technologies, their pedagogical use of locally developed GenAI tools, such as Wenxin Yiyan, Doubao, and Kimi, remains limited. Most participants reported using these tools informally for personal tasks such as summarizing information or drafting administrative text, but few had systematically integrated them into writing instruction. Instructors cited a lack of institutional support, training, and policy clarity as barriers to pedagogical adoption. These constraints suggest that while teachers may possess basic Technological Knowledge (TK), their ability to meaningfully integrate these tools into pedagogy and content, what TPACK defines as Technological Pedagogical Content Knowledge, is still underdeveloped in the context of local AI platforms.

Compared to widely studied global tools like ChatGPT, Grammarly, or Google Docs (Lo et al., 2024; Nguyen, 2023), local GenAI tools were largely absent from both research literature and structured training programs. This gap reflected not only a shortfall in empirical inquiry but also missed opportunities for professional development that were culturally and technologically contextualized. Without adequate guidance, even experienced educators may hesitate to experiment with new tools, particularly those that are still emerging in a local academic context.

Future studies might build on these findings by investigating how locally developed GenAI tools can be better integrated into EFL pedagogy through support for TPACK development. This included building technical fluency and helping teachers make pedagogical

decisions about when and how AI tools could enhance instruction. Institutions might consider offering training that bridges technological features with specific instructional applications, such as feedback strategies, genre modeling, or collaborative revision. Institutions also needed to develop clear policies and pedagogical guidelines for GenAI integration, provide targeted professional development on platform use, and work to reduce technical or access barriers so that instructors could confidently and ethically incorporate these technologies as pedagogical tools. Such efforts could better align technology integration with both teacher judgment and student learning needs, contributing to a more context-sensitive and pedagogically informed use of AI in EFL writing instruction.

Moreover, the study called for expanded research into localized GenAI tools in Chinese contexts and beyond. Comparative research across tools, regions, and disciplines will provide a fuller picture of how digital innovation reshapes language pedagogy in diverse educational settings.

Limitations

While this study offers valuable insights into EFL teachers' perceptions and practices regarding technology integration in writing instruction, several limitations should be acknowledged. First, the sample size was relatively small and limited to 7 participants from a specific subset of Chinese universities. Although efforts were made to include variation in university tier and regional distribution, the findings may not fully capture the diversity of experiences across the broader national context or among different types of institutions.

Second, the study relied on self-reported data through interviews and questionnaires, which may be subject to bias or selective recall. Teachers' descriptions of their practices might not always reflect their actual classroom behavior, particularly regarding tool usage or perceptions of student engagement.

Third, the study focused exclusively on teachers' perspectives without collecting data from students or classroom observations. As a result, the analysis may not fully represent how

students respond to digital tools or their effectiveness in fostering learning outcomes, such as higher-order writing skills.

Finally, while several widely used and emerging GenAI tools were discussed, the rapid pace of technological change means that the study provides only a snapshot of a continuously evolving field. Further longitudinal and comparative research is needed to examine the sustained pedagogical impact of both global and local AI technologies in EFL writing instruction.

Conclusion

This study explored Chinese university EFL writing instructors' perceptions and practices regarding the integration of digital technologies into writing instruction after the abrupt outbreak of COVID-19 and the shift to online teaching mode. Grounded in the TPACK and PCK frameworks, the research revealed that while most instructors recognized the pedagogical potential of digital tools, their actual usage varied widely depending on institutional tier, technological proficiency, and regional context. Teachers in better-resourced institutions with higher TPACK competence were more likely to integrate tools such as Peerceptiv, Pigaiwang, and AI-generated feedback meaningfully into writing pedagogy. Others, constrained by workload or insufficient training, adopted these technologies more superficially or for administrative convenience.

Importantly, the study showed that well-integrated digital tools can support the development of students' higher-order writing skills, including analysis, evaluation, and revision. However, such outcomes depend on tool availability and how teachers scaffold their use, reinforcing the critical role of pedagogical knowledge and student awareness in effective technology-mediated instruction.

A further contribution of this study lies in highlighting the underrepresentation of localized GenAI platforms, such as Wenxin Yiyao and Doubao, in both practice and research. The findings point to a lack of institutional policies, training, and confidence that may prevent these domestic tools from being fully adopted despite their growing presence in China's digital

landscape. This raises important questions for both local and global researchers about equitable access to technology and contextually appropriate integration strategies.

Although the study was limited by its small sample size and exclusive focus on teacher perspectives, it provides a valuable foundation for future investigations on technological support for EFL writing instruction. Further research should incorporate student voices, conduct longitudinal studies on tool impact, and explore how contextualized professional development can enhance teachers' TPACK and PCK in the EFL writing classroom. As GenAI and digital platforms continue to evolve, the pedagogical choices teachers make and the knowledge they rely on will remain central to navigating a rapidly transforming educational environment.

CHAPTER 5 Discussion

This dissertation examined how technology could meaningfully support EFL academic writing—at the level of task design (Study 1), collaborative process (Study 2), and teacher practice within real institutions (Study 3). Drawing on a controlled classroom experiment, a meta-analysis, and a qualitative interview study with Chinese university instructors, it argued that technology improved writing when it was aligned with genre goals and scaffolded by pedagogy (TPACK/PCK), training, and institutional support.

Integration with Broader Literature

The collective findings of this dissertation contributed to a growing body of research on L2 writing instruction, technology integration, and the sociocultural dimensions of learning. Across the three studies, the results supported long-standing arguments that writing development was strengthened when instructional supports helped learners externalize idea structures and engage in meaningful interaction throughout the writing process. This mirrored process-oriented perspectives that conceptualized writing as a recursive activity involving planning, organizing, drafting, and revising, and in which explicit scaffolding played an essential role in shaping the quality of learner output (Flower & Hayes, 1981).

The results also reinforced established insights regarding the role of collaboration in L2 writing. Prior research consistently showed that joint text construction enabled learners to negotiate meaning, co-construct ideas, and attend to form and content simultaneously (Storch, 2013; Swain, 2000). The significant overall effect of web-based collaboration observed in the meta-analysis strengthened this line of inquiry by demonstrating that technological mediation could extend the space for interaction across time and place, supporting revision and sustained engagement in both synchronous and asynchronous conditions (Abrams, 2016; Alharbi, 2019).

The identification of moderators such as training and group size further aligned with collaborative writing research emphasizing that the success of co-authoring depended on explicit expectations, structured roles, and shared routines (Bagherpour et al., 2017).

The qualitative findings deepened these insights by foregrounding the central role of teachers in mediating technology use. Research on technology integration in EFL contexts consistently found that teacher beliefs, technological knowledge, and institutional environments shaped how tools were adopted and sustained in writing classrooms (Albirini, 2006; Alghamdi & Holland, 2020). Instructors in this dissertation described both opportunities and constraints in using digital platforms, citing increased flexibility and efficiency as well as challenges such as student over-reliance on automated feedback, varying levels of digital literacy, and concerns about academic integrity—particularly with the rise of AI-based tools. These perspectives echoed broader concerns raised in the literature regarding equitable access, infrastructure, and professional development in technology-enhanced learning environments (Bao, 2020; Barrot et al., 2021).

Taken together, the findings across the three studies reinforced a central insight in the broader literature: technology enhanced EFL writing not through its presence alone but through its alignment with pedagogical goals, genre demands, and instructional contexts. Visual scaffolding facilitated planning and comprehension in genres requiring information consolidation; collaborative digital tools supported socially mediated meaning-making; and teacher expertise shaped whether tools were used to cultivate deeper learning or merely surface-level edits. This aligned with the TPACK framework, which positioned effective technology use at the intersection of technological, pedagogical, and content knowledge (Mishra & Koehler, 2006).

Overarching Themes and Connections

The three studies converged on a hybrid view of writing that integrated process and sociocultural perspectives, extending them with a task–tool–genre alignment lens. Study 1

demonstrated how visual planning affected planning and information integration. Study 2 showed the benefits of socially mediated drafting and revision, and Study 3 situated enactment within teachers' knowledge and institutional conditions. Together, they argued that the effects of technologies depended on the genre and task demands, design scaffolds such as training, and the capacity of teachers and institutions. Therefore, the studies moved beyond tool-centric claims toward a situated account of digital pedagogy in EFL writing and writing instruction.

Across the three studies, genre operated as a meaningful lever for technology's impact on writing. Study 1 showed a clear boundary: creating an infographic before drafting improved summary writing but did not lift short opinion writing. The gain in summaries was consistent with tasks that required accurate selection and structured presentation of source information, which a visual plan made visible before composing. By contrast, opinion writing demanded stance, warrants, and audience-directed reasoning that were not directly scaffolded by the infographic routine used here. Study 2 pointed in the same direction. Web-based collaboration benefited writing overall, and the estimate was larger, although not statistically reliable, for argumentative tasks—a pattern consistent with the negotiation and reasoning that collaborative platforms tend to support. Study 3 added texture from classrooms: instructors aligned tool use with task demands when they staged peer response around coherence and logic or positioned automated feedback for language-focused work. Taken together, the evidence suggested that technology was most effective when its affordances aligned with the genre's central moves, and it cautioned against assuming a uniform benefit across task types.

Delivery context formed the second cross-cutting thread. Study 2 found that the advantage of web-based collaborative writing traveled across time and place. Effects were observed in both synchronous and asynchronous conditions, as well as in and out of class. Training strengthened outcomes, but the core benefit did not depend on when or where collaboration occurred. Study 3 reflected this portability in day-to-day practice. Teachers used shared editors and conferencing tools to keep drafts and comments visible, sustain peer review,

and extend revision beyond scheduled meetings, even as they managed uneven online participation and workload. Study 1, conducted in regular course sections, demonstrated that targeted planning support can be effectively embedded in routine instruction without requiring special scheduling. The findings indicated that once tasks and scaffolds were well specified, the collaborative and planning benefits of technology were not tied to a single delivery mode, making them adaptable to hybrid timetables and local constraints.

Theoretical and Application Contributions

This dissertation presents a consolidated account of technology-enhanced EFL writing, integrating cognitive and sociocultural perspectives into a single, situated explanation of how tools, tasks, and genres interact in real-world courses. In theoretical terms, it aligned with and extended Graham's (2018) Writer(s)-Within-Community (WWC) model, which merged cognitive and sociocultural views and treated writing as the joint product of individual resources (eg. digital tools, technological platforms, AI tools, etc.) and the communities (writing class, collaborative groups, teaching departments and institutions) where writing occurs. In this framework, technologies functioned as community resources that amplified planning, collaboration, and feedback when aligned with writers' goals and local support. In doing so, the work moved beyond tool-centric claims toward community-anchored approaches, focusing on how EFL instructors and learners planned, negotiated, and revised with support that was both cognitively developed and socially interactive.

The work also made novel contributions to the literature by demonstrating, with converging evidence, how digital tools enhanced EFL academic writing and how these improvements were sustained across real-world instructional settings. Study 1 provided genre-differentiated evidence that visual planning benefits source-based summaries, anchoring gains in observable dimensions such as organization and source integration. Study 2 provided outcome-level detail and delivery-mode robustness, indicating a moderate overall advantage for web-based collaboration and portability across synchronous and asynchronous work, as well as

in- and out-of-class conditions. Study 3 supplied practice-proximal accounts of enactment under concrete constraints of policy, access, and institutional culture, including instructors' cautious positioning of GenAI. Together, these contributions yielded a transferable framework of effective technology use in EFL academic writing. It depended on the fit between task demands and tool affordances, realized through collaborative workflows that made revisions visible and supported by contexts in which teachers could act.

Methodologically, the dissertation demonstrated the value of multi-angle evidence for complex pedagogical questions. Run inside an actual course, Study 1 indicated that infographic planning helped when tasks required selecting and organizing source information (summaries) but not when they required stance and argumentation (opinions), a boundary condition single-genre trials might have missed. The meta-analysis provided external validity, quantified an overall benefit, and probed moderators using robust variance estimation; it also signaled areas where evidence was suggestive but underpowered, such as genre and group size. The qualitative inquiry added explanatory depth by tracing how teacher knowledge, policy, and infrastructure conditioned enactment. Taken together, the designs corroborated and complemented one another: experimentation showed what could work, synthesis estimated how much and under which conditions, and qualitative analysis explained why effects varied across contexts and over time.

For future practice, the dissertation provided a three-level application of technologies. At the classroom level, planning and collaboration were most effective when they were explicitly aligned to task demands and made visible in the writing cycle. For source-based assignments, instructors embedded a short, scored planning phase to enable students to organize key information and relationships before drafting. Evaluation targets emphasized content coverage, coherence, integration, and elaboration, which aligned with the rubric dimensions that evolved in Study 1. For multi-author tasks, courses adopted a stable web-based editor with version history and commenting, structured peer-response criteria, and short, explicit training in both tool

features and collaborative moves; Study 2 showed larger gains where training was present and showed that collaboration worked equally well in or out of class and in synchronous or asynchronous modes, which allowed schedules to flex without loss. Conferencing channels were kept open for brief consultations that pushed revision between class meetings, and lightweight checks focused attention on higher-order work while automated feedback handled routine language issues. These steps treated planning and collaboration as integral parts of the writing process, rather than add-ons, and they were applicable across various delivery modes.

At the program level, the studies supported settling on a small, dependable toolset and investing in practice-proximal professional learning so teachers could tie platform features to concrete writing goals. Departments standardized a core editor that preserved drafts and comments, paired it with a reliable live platform for conferences, and published concise protocols for peer review and the order of operations in drafting, responding, and revising. Professional development centered on TPACK/PCK integration—modeling how to stage tools to support idea development, audience awareness, and revision—rather than tool tours. After the rapid shift online, instructors continued to use recorded micro-lectures for difficult concepts and relied on messaging channels for quick clarifications; these routines reduced friction in hybrid delivery but still needed institutional support to be sustained. Study 3 highlighted the importance of clear, public guidance on acceptable AI assistance and disclosure, along with training that enables teachers to use AI, if at all, after independent drafting and for limited purposes that do not replace composing.

At the policy and leadership level, the WWC model helped translate evidence into community supports. Tools were treated as community resources rather than ends in themselves; leaders and program designers created conditions—stable infrastructure, norms for collaboration and feedback, ethical AI guidance, and scheduled training—so that writers could participate in shared, visible practices across courses. This community view explained why Study 2’s portability across time and place aligned with Study 3’s reports of day-to-day

web-based collaboration, and why Study 1's genre-sensitive planning effects required matching the support to the task rather than expecting uniform gains. In short, investments in people, routines, and environments enabled tools to amplify planning, collaboration, and feedback in ways the WWC model predicts.

Limitations

Several limitations constrained the findings of this dissertation and pointed toward next steps. Two studies were set in Chinese universities. Multi-site projects across regions could test whether the patterns observed here held where assessment regimes and levels of technological access differed. Sampling could be larger and more diverse, with student-level randomization when feasible, to separate tool effects from class or instructor effects. Measurement could be broadened. In addition to essay scores and analytic rubrics, future studies might track longer-term growth, transfer to new tasks, and genre-specific discourse moves. Process data could also reveal mechanisms—such as comment threads, edit sequences, and feedback uptake across drafts—an especially important consideration for collaborative writing, where prior work called for richer reporting of implementation and teacher involvement.

Reporting practices also required strengthening. Pre-registration, clearer fidelity checks, and transparent descriptions of training, scripts, and platform functions would enhance future syntheses and make moderator analyses more informative. Finally, given the rapidly evolving tool landscape, comparative and longitudinal studies should follow cohorts as platforms and policies shifted, including cases in which international services were restricted and domestic alternatives were used. Such work would clarify which practices were durable and which depended on specific infrastructures.

The dissertation's three studies converge on a simple, transferable idea: technology supports EFL academic writing when its affordances are matched to genre demands, when collaboration makes revision work visible and consequential, and when local conditions allow

instructors to enact that alignment. Visual planning with infographics enhances source-based summary writing; web-based collaboration improves global quality and accuracy across delivery modes; and instructors' decisions, shaped by policy and access, determine whether these gains persist in everyday classrooms. By connecting genre-level effects, collaborative mechanisms, and context-sensitive enactment, the project offers a coherent blueprint for designing equitable, high-impact writing instruction in EFL higher education.

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