

Written Corrective Feedback Scientometric Review (1987–2022)

Xuan Wang

School of Foreign Studies
Northwestern Polytechnical University, China

Jingying Zuo

School of Foreign Studies
Northwestern Polytechnical University, China
Corresponding Author: jingyingzuo@mail.nwpu.edu.cn

Xinyi Wang

School of Foreign Studies
Northwestern Polytechnical University, China

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Abstract

Written corrective feedback is widely used in language learning and teaching, and related studies have attracted significant attention in recent years. Through analysis and visualization of 497 articles indexed in the Web of Science core collection over the past 35 years using CiteSpace, this scientometric review aims to explore the developmental stages, involved disciplines, geospatial fingerprint, main research streams, and emerging research trends of written corrective feedback. The following stages were identified based on the timeline of publications and citations: the sprouting phase (1987–2005), the fluctuating phase (2006–2016), and the explosive phase (2017–2022). The interdisciplinary trend toward written corrective feedback becomes increasingly prominent throughout each stage, and its primary disciplines range from linguistics and cognitive science to psychology and computer science. The primary research contexts for written corrective feedback research are ESL and EFL; countries with multiple coexisting language variants have prioritized research in this field. Existing studies have witnessed a shift from quantitative to qualitative research, and case studies focusing on individual differences are emerging as a newer research frontier. As one of the first few scientometric reviews of written corrective feedback since the phrase first appeared as a combined index term, this study is significant as a reference for comprehensively understanding the intellectual background, dynamics, and evolution of this research field.

Keywords: CiteSpace, co-citation, language learning, scientometrics, written corrective feedback

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Introduction

Written Corrective Feedback (WCF), an essential component of instructed language acquisition, assists language learners in noticing gaps in their knowledge, improving their language production accuracy, and identifying their learning objectives (Barrot, 2023; Chen et al., 2022; Moradkhani & Mansouri, 2023; Shen & Chong, 2023). Existing studies have conducted extensive, in-depth discussions on the effectiveness of WCF and what factors mediate the effects of WCF, but there are still spaces to be explored. First, numerous empirical studies on the subject show controversial findings (Lee, 2019; Li & Vuono, 2019; Patra et al., 2022; Yu et al., 2021); relatively few articles provide a review of the field, but it is crucial to investigate its current state and clarify future research trends. Second, most of the reviews in the literature use traditional approaches (Cao & Mao, 2022; Li & Vuono, 2019; Zhou et al., 2022), but few use scientometric approaches, which are suitable for large literature volumes and complex research topics (Chen et al., 2014). Third, a limited number of studies have employed a visualization approach, as most have primarily concentrated on Second Language (L2) writing or have restricted their scope to a specific timeframe within an artificial context rather than employing a systematic selection procedure (Miao et al., 2023). However, WCF research encompasses not only L2 writing instruction but also instruction in first language (L1) grammar and writing (Biber et al., 2011; Bitchener & Ferris, 2012; Sinha & Nassaji, 2022). Therefore, this article aims to conduct a scientometric review of publications on WCF in a comprehensive context, incorporating the timeframe from 1987, when the term “written corrective feedback” first emerged as a unified phrase in the Web of Science (WOS) core collection, to 2022.

This review comprises analysis and visualization of the development stages, involved disciplines, practicing countries (regions), main research streams, and emerging research areas of WCF research. It aims to review WCF research from a broader, more diverse, and more systematic approach, which can provide additional research value to the traditional review approach. The research questions addressed in this review are:

1. What are the research status and evolutionary characteristics of WCF?
2. Which disciplines are involved in WCF?
3. What is the geographical distribution of articles on WCF?
4. What major themes emerge in WCF research?
5. What trends are emerging in the field of WCF?

Literature Review

Written Corrective Feedback refers to all written comments or feedback aimed at rectifying the errors in language learners' language production (Kang & Han, 2015; Kurzer, 2018). Its effectiveness began to be researched in L1 writing and grammar (Knoblauch & Brannon, 1981; Leki, 1990) and was then widely researched in English as a Foreign Language (EFL)/English as Second Language (ESL) contexts (Abdullah et al., 2021; Aknouch et al., 2022; Cho & Kim, 2022; Zabihi & Erfanitabar, 2021). Despite being widely used in teaching practice, the efficacy of WCF remains controversial (Cho et al., 2022; Shin, 2022). Supported by Schmidt's (2011) noticing hypothesis, the debate between Truscott (1996) and Ferris (1999) over the efficacy of WCF in the mid-to-late-1990s brought research on WCF to the forefront. Truscott (1996) claimed that “grammar correction has no place in writing courses and should be abandoned” (p. 328). While some scholars supported this view (Kepner, 1991; Polio et al., 1998), others, represented by Ferris (1999), refuted it through many empirical studies (Bitchener & Knoch, 2008; Guenette, 2007;

Sheen, 2007). Other debates in the literature revolve around the applicability of WCF to all types of writing errors and the comparative effectiveness of different types of WCF in enhancing learners' writing accuracy (Kim et al., 2020; Shin, 2022; Zabihi & Erfanitabar, 2021).

The conceptual framework of WCF is complex, and one manifestation of that complexity is the diversity of its categorical dimensions. Currently, the classification of WCF into direct and indirect WCF is one of the more accepted classification methods (Chandler, 2003; Ellis et al., 2008; Li & Roshan, 2019; Shintani et al., 2014). *Direct WCF* means more advanced language users (e.g., L2 teachers) not only point out mistakes in students' writing but also provide them with the correct expressions. *Indirect WCF*, on the other hand, means that although errors are pointed out via underlining, circling, or another method, the corresponding correct forms are not provided (Shin, 2022). Concerning the time of WCF application, a classification beyond direct and indirect has been proposed (Kim et al., 2020): *asynchronous WCF* (AWCF) refers to the feedback provided outside of the classroom once the writing process is completed, while *synchronous WCF* (SWCF) pertains to the error correction provided to students who are still engaged in a writing task.

Due to its contextual complexity, WCF is vulnerable to various external factors (Lee, 2013). Research has shown that the ultimate effectiveness of WCF is determined by the contextual and affective factors of teachers and learners (Goldstein, 2004; Storch & Wigglesworth, 2010). Previous studies from the perspective of L2 teachers follow a second language acquisition (SLA) perspective to explore the effects of teachers' WCF and other feedback strategies (Ferris, 2010; Mujtaba et al., 2020). Li and Roshan (2019) investigated two groups of teachers and the focuses of their respective feedback, finding that two knowledge categories—beliefs about the subject matter and knowledge of the English language—are closely related to the feedback focus. More recent studies focus on how L2 learners' individual differences and subjective motivations affect the efficacy of WCF and how WCF may negatively affect their academic emotions (Alharbi, 2022; Chen, 2022; Cheng & Zhang, 2021). L2 learners were found to consciously, intentionally, and strategically choose whether to engage with or solicit WCF based on cost and value calculations (Papi et al., 2020).

WCF has been extensively researched in second or foreign language learning and has become a topical issue in L2 writing. In addition to the complex construct of WCF, its interdisciplinary integration with linguistics also provides various new directions for WCF research. Existing research on WCF is mainly empirical, and due to numerous mediating factors, academia has not reached a consensus on its effectiveness. Therefore, a comprehensive review is needed to establish a systematic research paradigm and a solid theoretical foundation in the field.

Method

The research method utilized in this study is primarily based on the theory of mapping knowledge domains in scientometrics. This approach combines applied mathematics, graphics, information visualization technology, information science, and metrology. By employing these interdisciplinary techniques, researchers can effectively visualize one research topic's core structure, development history, frontier fields, and overall knowledge framework (Vogel, 2014).

Data Source

This study utilizes data from the Web of Science (WoS) core collection database, which is the primary journal citation index database within the American Institute for Scientific Information (ISI) database. The WoS database consists of high-quality journal articles that undergo rigorous

peer review and have a global impact (Guo, 2022; Roemer & Borchardt, 2015). To further ensure the quality and relativity of the literature in the database used for the visual analysis, this review selected publications from the WoS core social collection, including Social Science Citation Index (SSCI) and the Arts and Humanities Citation Index (AHCI). SSCI is a multidisciplinary and comprehensive citation database that covers reputable social science journals in different countries and regions; AHCI is a critical periodical abstracts index database in the arts and humanities field, with data collected from 1975 to the present.

Our research focused on published articles and review articles of WCF research. With “written corrective feedback” OR (“corrective feedback” AND “writing”) OR “written error correction” OR (“error correction” AND “writing”) OR (“error feedback” AND “writing”) as search strings, topic retrieval was chosen to ensure all WCF studies included in the SSCI and AHCI databases were covered as best as possible. The period in this study was set between 1987 and 2022 since WCF research was first searchable in 1987. After manually verifying their relevance to WCF research and deduplication analysis, 497 publications with English as the writing language were retrieved as the analysis object to establish the data set in the current study.

Research Instruments

The CiteSpace 6.1 software developed and updated by Chaomei Chen was adopted in the current study to analyze and visualize the core structure, development history, frontier fields, and knowledge structure in different dimensions, such as distance, relationship, timeline, and overlay (Chen, 2017). Since its publication in 2004, CiteSpace has found extensive application across diverse disciplines. Numerous review studies in the field of linguistics field have started to use CiteSpace to understand the development progress and research frontiers of a specific research topic within the discipline (Guo, 2022; Jiang & Fan, 2022; Lim & Aryadoust, 2022; Wang et al., 2023).

Results

Research Development Stages

The number of publications is an important index to indicate the development trend of a particular field in a specific period. When a graph is used to depict the data, the historical development in a field is shown more intuitively, which has great value when analyzing the development trend of a certain field and predicting its future development (Guo et al., 2022). A stable number indicates the field has entered a bottleneck and the difficulty of innovation has increased; an increasing number indicates the field is active in that year; and a decreasing number indicates the motivation for innovation in the field is insufficient. Based on 497 publications related to WCF retrieved from the WoS for this study, the annual distribution of literature and citations in this field was mapped (in Figure One) to display the development trend visually. In general, WCF research has progressed through three stages: the sprouting phase (1987–2005), the fluctuating phase (2006–2016), and the explosive phase (2017–2022).

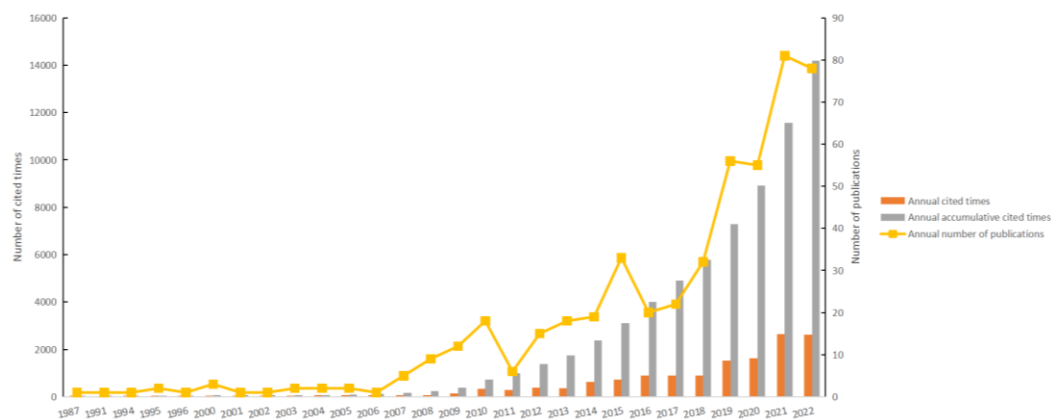


Figure 1. Yearly distribution of WCF publication in WoS from 1987 to 2022

The Sprouting Stage (1987–2005)

The emphasis on WCF initially emerged during this stage in English writing classes, where the error correction concept was formally introduced. At that time, this concept was commonly known as grammar correction and relatively consistent. Scholars and L2 teachers also agreed that grammar correction should be part of the L2 writing curriculum. However, Truscott (1996) reviewed previous research and suggested that grammar correction was ineffective in L2 writing classes. This led to increased attention from researchers in the field of L2 writing studies to the topic of WCF, and numerous subsequent studies have since focused on examining its effectiveness (Chandler, 2003). In March 2000, the American Association of Applied Linguistics (AAAL) held a conference in Vancouver and discussed error correction in language teaching, which fueled the emergence of empirical research about WCF.

The Fluctuating Phase (2006–2016)

From 2006 to 2016, the number of research publications covering WCF experienced a period of fluctuating increase. However, the number of WCF research citations still experienced an explosive increase during this period, indicating it was an essential time of theoretical exploration and construction of WCF research; this decade was later considered to have laid the theoretical foundation for the WCF field. More than half of the Top 10 most-cited publications focused on WCF during 1987–2022 (see Supplementary Table A) were published between 2006 and 2016, providing theoretical guidance for further conceptual frameworks and research methods.

The Conceptual Framework of WCF

Researchers during this period enriched and refined the conceptual framework of WCF, specifying its classification. For example, Ellis (2009) classified the types of feedback into direct correction, indirect correction, focused correction, unfocused correction, electronic correction, and reformulation from the perspective of strategies for providing feedback. This typology provided a theoretical basis for researchers to explore the comparative effectiveness of different types of WCF systematically.

The Research Methodology of WCF

Most cited papers provided methodology guidance for the design of empirical studies. To verify the effectiveness of WCF, studies must quantify and compare the results produced with and

without WCF. Controlled experiments were a standard method that required researchers to set up an experimental group that received WCF and a control group that did not. After a period of writing practice, the effectiveness of WCF could be determined by comparing the performance of the two groups (Bitchener, 2008; Chandler, 2003; Sheen, 2007). Another standard experiment design focused on the same group of participants. It determined whether their writing proficiency improved after receiving WCF through successive “pre-test-immediate post-test-delayed post-tests” (Ellis et al., 2008, p.353).

The Explosive Phase (2017–2022)

Guided by a solid disciplinary base, WCF research entered an explosive period of diversification in recent years, as evidenced by the increase in annual publications and the growing variety of research topics. From 2017 to 2022, research on the factors influencing the effectiveness of WCF has expanded beyond teacher and time factors to include learner and linguistic factors. These learner factors encompass language proficiency, academic ability, linguistic background, language beliefs, learning goals, language context, and cognitive ability. Additionally, linguistic factors such as the types of errors, including morphology, syntax, spelling, and punctuation, have also been considered in recent studies (Lee & Du, 2021; Moser, 2020; Nowbakht & Olive, 2021). In addition, WCF research became more integrated with information technology, with automated written evaluation (AWE) provided by automated correction software such as *Grammarly*, further enhancing the WCF classification framework (Fu & Liu, 2022; Lee & Briggs, 2021). During the explosive phase, WCF research became one of the research frontiers in L2 writing research; researchers considered the factors of L2 writing subjects’ self-efficacy and individual differences comprehensively; the research articles were still mainly empirical studies.

Discipline Research Analysis

The analysis of disciplines related to WCF research helped identify the attribution of academic publications, authoritative journals, and the perspective of researchers in this field. Through mapping the dual-map overlay and collecting statistics of source journals and discipline distribution, this study aimed to understand the disciplinary areas involved in WCF research and the research dynamics in each area over the past 30 years.

Dual-map Overlay

The dual-map overlay generated by CiteSpace, taking the scientific map as the base map for analysis, formed the disciplinary co-occurrence network by superimposing the information of the analyzed data and visually presenting the interaction between the analyzed data and the relevant knowledge sources (Chen & Leydesdorff, 2014). The Blondel algorithm clustered journals publishing existing academic results of WCF research. As shown in Figure Two, multiple labels presented in the dual-map overlay were extracted from journal titles of related disciplines. Citation journals are shown on the left, reflecting the academic application of WCF research, while cited journals are shown on the right and represent the theoretical basis of WCF. The arcs connecting the left and right figures indicate citation links. Through the aggregation of the z-score function, the wider the arcs, the closer and more critical the link. Ovals in the bottom right corner of Figure Two represent the number of scholarly outputs and authors in the WCF field—the larger the oval, the more published papers.

In Figure Two, the links between the cited and cited journals are concentrated, reflecting

the distinctive disciplinary character of WCF research. The most important connection existed between “Psychology, Education, Health” on the left and “Psychology, Education, Social” on the right ($z = 5.18334335$, $f = 25,176$), indicating not only that the social sciences—represented by psychology, education, and health—were the main areas of concern for WCF, but also that the disciplines of psychology, education, and social provide solid theoretical support for WCF research. In addition, the arc from “Psychology, Education, Health” to “Systems, Computing, Computer” indicated one of the significant links in dual-map overlay in line with the trend toward computers providing automatic written feedback in teaching practice. Notably, the most significant number of academic outputs related to WCF were published in the *Journal of Second Language Writing* (51), which was also the largest source of cited articles in this field (2,754). When conducting research related to WCF, the *Journal of Second Language Writing* deserves attention.

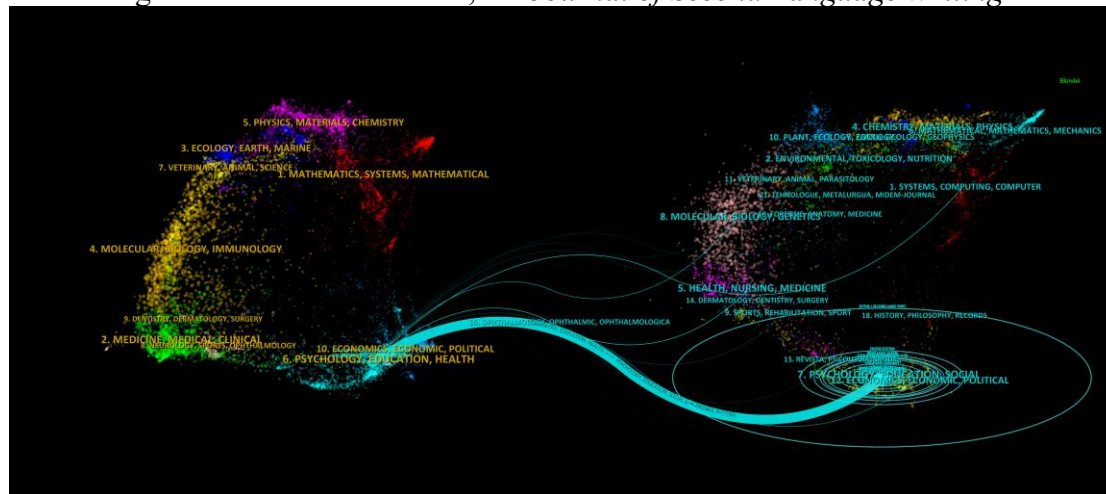


Figure 2. Dual-map overlay for WCF research

Discipline Analysis

Academic journals are one of the primary ways to make academic results accessible to the public and reflect the major disciplines involved in each field of study. Publications cited in a particular field can be considered knowledge sources in that field (Chen & Leydesdorff, 2014). In the field of WCF, the representative cited journals were explored through the analysis of cited journals in CiteSpace, among which the Top 10 are listed in Table One. The primary sources of knowledge for WCF are thus clearly the high-quality traditional linguistic journals, represented by the *Journal of Second Language Writing*, *System*, *Modern Language Journal*, and *Applied Linguistics*. These sources also show that the concept of WCF has its roots in linguistics and that SLA is the leading research perspective.

Table 1. Top 10 most-cited journals

No.	Journal	Cited times	Centrality	JCR
1	<i>Journal of Second Language Writing</i>	400	0.01	Q1
2	<i>System</i>	350	0.01	Q1
3	<i>Language Learning</i>	316	0.01	Q1
4	<i>TESOL Quarterly</i>	314	0.01	Q1
5	<i>Study in Second Language Acquisition</i>	287	0.02	Q1
6	<i>Modern Language Journal</i>	286	0.02	Q1
7	<i>Language Teaching Research</i>	246	0.01	Q1
8	<i>Applied Linguistics</i>	232	0.06	Q1

9	<i>ELT Journal</i>	204	0.02	Q1
10	<i>Assessing Writing</i>	185	0.08	Q1

Table Two presents the Top 10 journals with numerous articles in the field of WCF. Articles published in these journals constitute the current frontier of WCF research. IF indicates the total number of citations of a journal, while the index of JCR reflects the quality and impact of a journal, with Q1 representing the highest quality category of journals in a discipline. In the field of WCF, the *Journal of Second Language Writing* (51), *System* (42), *Language Teaching Research* (28), *Assessing Writing* (27), *Computer Assisted Language Learning* (26), *Language Learning Technology* (20), *Frontiers in Psychology* (12), *IRAL – International Review of Applied Linguistics in Language Teaching* (10), *Language Awareness* (10), and *TESOL Quarterly* (10) were journals with numerous articles, with a total of 47.46% of the articles published.

Table 2. *Top 10 journals with numerous articles*

No.	Journal	IF	Centrality	Percentage	JCR
1	<i>Journal of Second Language Writing</i>	2.55	51	10.26%	Q1
2	<i>System</i>	2.22	42	8.45%	Q1
3	<i>Language Teaching Research</i>	2.29	28	5.63%	Q1
4	<i>Assessing Writing</i>	1.82	27	5.43%	Q1
5	<i>Computer Assisted Language Learning</i>	3.57	26	5.23%	Q1
6	<i>Language Learning Technology</i>	2.12	20	4.02%	Q1
7	<i>Frontiers in Psychology</i>	1.03	12	2.41%	Q1
8	<i>IRAL - International Review of Applied Linguistics in Language Teaching</i>	1.2	10	2.01%	Q2
9	<i>Language Awareness</i>	1.49	10	2.01%	Q2
10	<i>TESOL Quarterly</i>	1.9	10	2.01%	Q1

Based on the comprehensive analysis presented in Tables One and Two, the most productive journal and the most cited journal were both the *Journal of Second Language Writing*, which was a direct indication of the importance of this journal in WCF research. Additionally, *Computer Assisted Language Learning*, *Language Learning Technology*, *Frontiers in Psychology*, *IRAL – International Journal of Applied Linguistics in Language Teaching and Awareness*, and *Language Awareness* appear in Table Two only as the journals that have published the most WCF-related research in recent years. This finding directly reflects that, as WCF research progresses, research in computer technology, cognitive science, and pedagogy are becoming key new disciplines in the field. The trend of interdisciplinary and even multidisciplinary research has become a dynamic new area of WCF research.

Geospatial Analysis of Publications

The geospatial analysis of publications can identify academic emphasis in one research field in different countries and regions (Liu & Brown, 2015). Based on retrieving and selecting data from WoS and CiteSpace, the details of the Top 10 countries (regions) in WCF research are shown in Supplementary Table B. Between 1987 and 2022, the United States and China can be considered the dominant forces in WCF research, for they have both the highest number of publications and the highest H-index (to assess the quantity and quality of researchers' academic output) among the Top 10 countries (regions). The influence of a country or region in a particular research field can also be reflected in the number of citations in the publications. The United States, China, New Zealand, and Australia are the countries with the highest number of publication

citations in the WCF field, meaning they have a relatively significant influence on WCF research. Notably, New Zealand (75.86%), South Korea (63.16%), and Australia (54.84%) are the first three in terms of cooperation rate, which indicates that these countries (regions) are active in transnational research on WCF.

Based on the geospatial analysis of WCF publications, first, the major publishing institutions in the field of WCF are all universities, which directly reflects that traditional academic institutions still promote development in WCF research. Second, the language environment of the Top 10 countries with the largest WCF publications is relatively complex. Currently, WCF research is primarily conducted on learners who have acquired English as an L2. In the Top 10 countries, English primarily plays a role as ESL or EFL, indicating that WCF research is primarily conducted in ESL or EFL contexts. Finally, almost every country (region) has refined its research focus within the upper dimension of WCF. For example, China and the United Kingdom focus on “student engagement,” while New Zealand focuses on “task complexity.” It also suggests that WCF is a complex concept with a rich internal structure sensitive to external factors (e.g., stakeholders and context).

Main Research Streams of WCF

Through the analysis of co-citation status and citation burst, this study explored the existing main themes and hotspots of WCF research. By performing document co-citation analysis (DCA), the details of key literature with a high citation frequency, intellectual domains, and research themes related to this research topic could be directly visualized (Chen et al., 2010). According to Small (1973), if a third document cited two documents together, the two documents constituted a co-citation relationship. This study conducted DCA on 497 WCF documents using CiteSpace, and clusters were generated using the LLR algorithm (Figure Three). The parameters of CiteSpace were set as follows: g-index (k=25), LRF=3.0, L/N=10, LBY=5, and e=1.0. The Co-citation WCF network included 800 nodes and 3,186 links. With a modularity of 0.7445 and a weighted mean silhouette of 0.896, the map was well-structured and meaningful to reflect the research status of WCF.

Through clustering, the main categories of WCF research were as follows: #0 error correction, #1 corrective feedback, #2 student engagement, #3 EFL writing, #4 grammar correction, #5 collaborative writing, #6 metalinguistic awareness, and #10 lexis. All categories showed a high degree of concentration, clearly reflecting that changes are emerging in WCF research themes: (a) The research focus on stakeholders involved in WCF concentrates more on the students (#2 student engagement). Since students are the recipients of WCF, researchers are interested in how different individual factors interact with the external environment to influence learners' understanding and adoption of WCF (Han & Hyland, 2015; Hyland, 2013; Koltovskaia, 2020; Zheng & Yu, 2018). (b) The emphasis on the language context of WCF was increasing (#3 EFL writing). Cheng and Zhang (2021) used data from semi-structured interviews and student writing samples to explore how new writing teachers conceptualized and provided WCF in the context of EFL. (c) The correlation between the types of WCF and receivers' metalinguistic awareness was explored through extensive research (#6 metalinguistic awareness). Direct WCF, which provides grammar rules and examples of correct usage, can be seen as a metalinguistic explanation and benefit to improve students' meta-linguistic knowledge and awareness (Bitchener & Knoch, 2010). In Bitchener and Knoch's (2010) study, learners' writing accuracy improved during the 10-week experimental period by receiving WCF through meta-linguistic clarifications.

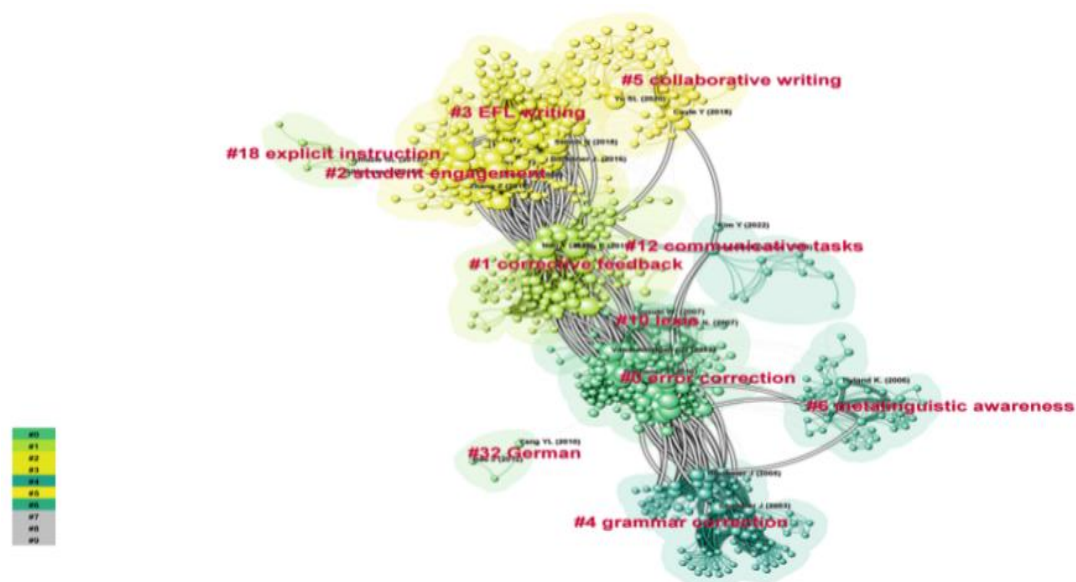


Figure 3. Co-citation WCF network clusters

In CiteSpace's algorithm, a burst represents a sharp increase in a particular object of analysis in a research field. Innovative research topics were identified to analyze the citation burst by determining the literature cited with high frequency during a given period. An emerging topic corresponded to a new research direction, from which the evolution of WCF research could be visualized.

Figure Four shows the 25 pieces of literature with the strongest citation bursts. The blue line in the figure shows the timeline, and the line segments marked in red represent the period during which the number of literature citations surged. As founders of WCF research, Jean Chandler, Dana Ferris, John Bitchener, and John Truscott were highly cited authors whose publications appeared several times. Van Beuningen et al.'s (2012) study continued to receive significant attention from 2012 to 2017, becoming one of the publications with the most extended citation burst. By conducting controlled experiments, they found that the writing accuracy of learners who received direct and indirect WCF was higher than that of learners who had not received any feedback. Meanwhile, direct WCF was beneficial to improving grammatical accuracy, while indirect WCF was beneficial to improving other linguistic accuracy. This study provided clear answers to both questions of "whether WCF was effective" and "which types of WCF were more effective," extensively promoting the development of WCF research. Zheng and Yu's (2018) research represented the latest research direction in the field of WCF, which focused on observing the emotion, behavior, and cognition of language learners in the face of the teacher's WCF, indicating that the focus of WCF was gradually shifting from studying WCF itself to the participation and experience of stakeholders, reflecting the trend of multidisciplinary research on WCF, cognitive science, and psychology.

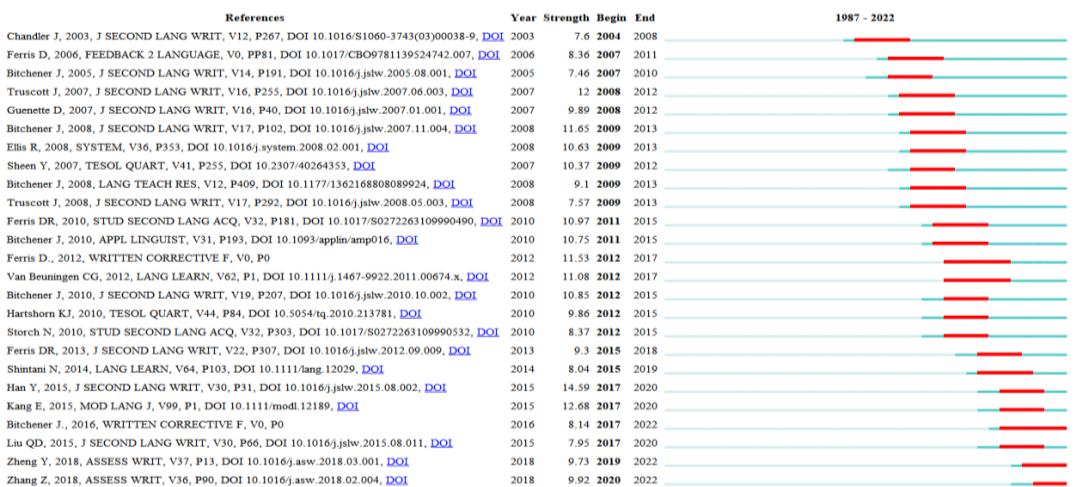


Figure 4. References with the strongest citation bursts

Emerging Research Areas

After the formation of clusters using the timeline function, a timeline of the WCF research conducted by networks from 1987 to 2022 was generated to provide a clear picture of the research trend (Chen, 2017). Clusters were arranged horizontally across the timeline; the timeline map offers a view of the overall development in the field to show whether trends lasted. After adaptation, as shown in Figure Five, from 1987 to 2022, there were 13 clusters in total. Emerging significantly, four clusters among the 13 are most distinguishable: #0 comprehensive corrective feedback, #2 AWE feedback, #4 direct correction, and #7 teachers’ beliefs.

Based on the mapping result, the emerging trend analysis can be classified into two groups: #0 comprehensive corrective feedback and #4 direct correction grouped to the content and form of the feedback; #2 AWE feedback and #7 teachers’ beliefs grouped to the influencing factors underlying WCF’s effect from the mediation perspective.

Comprehensive corrective feedback also means unfocused corrective feedback, which gives feedback on various categories of error and has been widely used in L2 writing classrooms (Ellis et al., 2008). Some scholars claimed that comprehensive corrective feedback would overwhelm learners, imposing a cognitive burden and thus hindering learners’ ability to correct themselves (Sheen et al., 2009). However, other research concluded that comprehensive corrective feedback research was not limited to the feedback scope but also included a lot of other variables, such as feedback explicitness, error type, and learner type (Lopez et al., 2018). Hence, whether comprehensive corrective feedback could be effective in writing class remained a heated discussion from 2020 to 2022.

Direct feedback was given in the form of reformulation, which involves rewriting the learners’ work while paying attention to grammatical and lexical problems and retaining as much of the original content as possible (Thornbury, 1997). Direct and indirect feedback was usually discussed together. According to Ferris and Hedgcock (2014), when comparing direct and indirect WCF, direct feedback helps to eliminate confusion and reduces learners’ cognitive load, allowing learners to test their hypotheses more directly. In contrast, indirect feedback is more helpful in fostering the internalization of the form and increasing metalinguistic information processing (Bitchener, 2012). Since 2020–2022, the discussion of direct feedback has greatly increased.

With the development of computer technology, the types of WCF have also undergone

innovations and enhancements. AWE feedback (i.e., automated written evaluation feedback) means computer-generated feedback. Due to the booming internet use and pandemic outburst, much attention was paid to computer-assisted feedback, with heavy importance attached to learners' self-engagement. Studies were primarily conducted in the setting of higher education. This recently highly developed written corrective feedback form has been intensely investigated from around 2020 to 2022. For example, Lee (2019) pointed out that teachers can encourage students to use computer-mediated resources to improve the accuracy of writing (e.g., using Microsoft Word) or web-based grammar checks (e.g., *Grammarly*) to monitor the student's written accuracy development. Barrot (2023) experimented to determine whether AWCF affects L2 learners' writing accuracy and found that AWCF is sound and that students' writing accuracy may be influenced by their engagement in self-learning.

Apart from WCF itself, researchers have noticed the interaction between students and teachers in WCF and teachers' role as feedback givers, especially from 2020 to 2022. Thus, the term *teacher belief* has been selected by CiteSpace. For example, Chen (2022) highlighted that teachers' beliefs are influenced by their different experiences and students' needs. Teachers' WCF could then vary according to their beliefs. Barrot (2023) stated that students who had used AWCF performed better than those who had not. Therefore, AWCF tools such as *Grammarly* could be helpful pedagogical tools in L2 writing classrooms. Vyatkina (2010) advocated that L2 educators should administer effective and efficient WCF to student writing and strategically combine different feedback forms.

Overall, the development of WCF research is maturing. The focus point of such research is gradually changing from the efficiency of WCF to the formation of WCF and other influencing factors. WCF research has also innovated with time. In the future, the research trends of #0 comprehensive corrective feedback, #2 AWE feedback, #4 direct correction, and #7 teachers' beliefs will likely develop further.

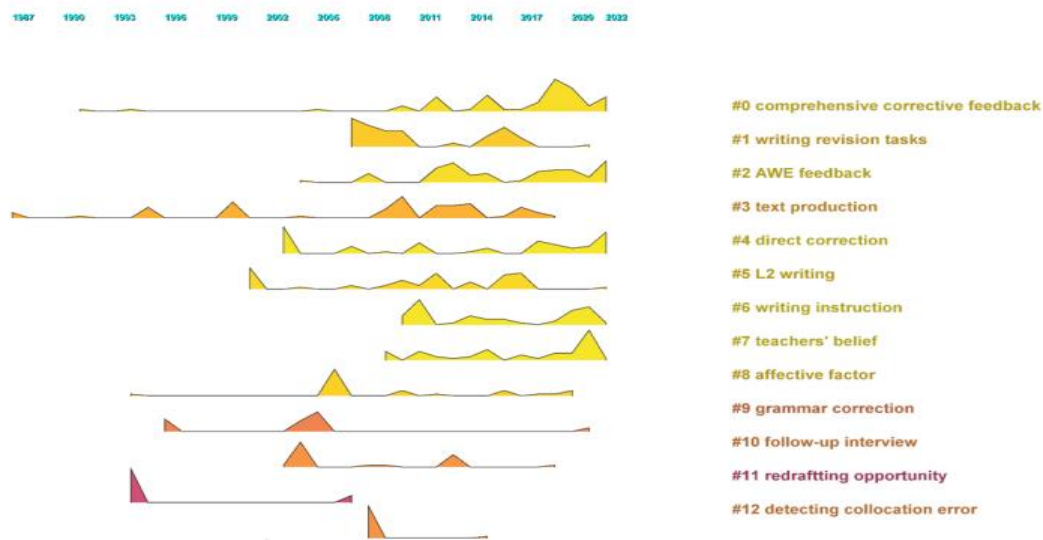


Figure 5. Keywords timeline

Short-term burst keyword mapping enabled the analysis of rapidly growing topics and increased understanding of research themes in recent years. As shown in Figure Six, the theme of WCF studies changed, and which topics became heated discussions can be identified. The node size represents the publication number, and the red circle around or in it means the topic is heatedly

discussed. The color of the “student engagement” and “belief” notes are among the reddest ones, indicating that the relationship between WCF and its stakeholders (e.g., students and teachers) has become the focus of recent studies. By investigating two novice EFL writing teachers’ beliefs and practices concerning WCF across contexts, Chen (2022) found inconsistencies between teachers’ beliefs and practices. This study also associated L2 teachers’ inconsistent practices with teachers’ identities and showed detailed illustrations of how teachers’ beliefs and practice systems interacted with specific educational and sociocultural contexts.

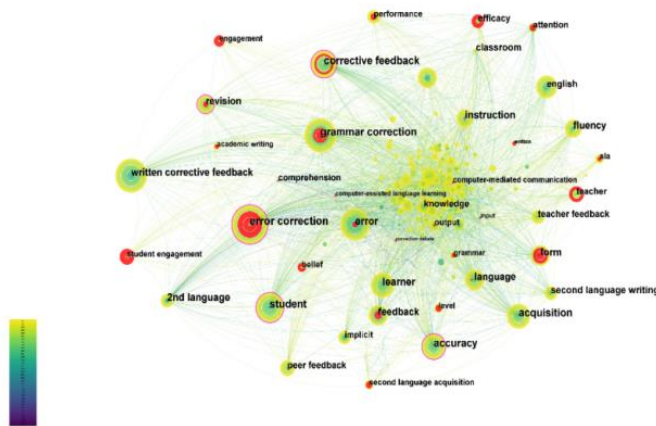


Figure 6. Keywords co-occurrence and burstiness

Discussion

Using a scientometric visual mapping approach, this study analyzed 497 WCF publications from 1987, when WCF was first made available as an independent concept in WoS, through 2022. It provided a clear and comprehensive knowledge landscape of WCF, including development stages, disciplinary involvement, main source countries and regions, primary research topics, and emerging research trends.

First, by counting the number of WCF research publications and citations between 1987 and 2022, a graph was generated to present the development stages of WCF research visually. This review found that research on WCF can be divided into the sprouting phase (1987–2005), the fluctuating phase (2006–2016), and the explosive phase (2017–2022), corresponding to scholarly interest in whether WCF is effective, which type of WCF is most effective, and what factors influence WCF, respectively. During the sprouting phase (1987–2005), Truscott’s (1996) review article *The Case Against Grammar Correction in L2 Writing Classes* was the most cited article in the field of WCF and Ferris’s (2002) monograph *Treatment of Error in Second Language Student Writing* laid a solid theoretical foundation for the development of this field. However, the results of studies in this phase have been influenced by experimental design (e.g., lack of pretesting, inconsistent pretest and posttest instruments, and lack of control groups), which means the effectiveness of WCF remains highly controversial. To address the inadequacy and incompleteness of existing studies and the inconsistency of experimental designs, Ferris (2004) and Truscott (2007) called for more and deeper empirical research. Thus, between 2006 and 2016, researchers expanded their research questions to include the effectiveness of different types of WCF in hopes of maximizing the utility of WCF. Following the construction of the WCF typological framework (Ellis, 2009), the effectiveness of direct WCF, indirect WCF, and meta-linguistic WCF from the categorical perspective of the strategy used to provide feedback has been widely discussed

(Bitchener & Knoch, 2008; Shintani & Ellis, 2013). Guided by a strong disciplinary base, WCF research entered an explosive period (2017–2022) of diversification, as evidenced by the increase in the number of annual publications and the growing variety of research topics. From 2017 to 2022, research on factors influencing the effectiveness of WCF expanded from teacher factors (different forms of WCF provided by L2 teachers) and time factors (short/long term) to include learner factors (language proficiency, academic ability, linguistic background, language beliefs, learning goals, language context, cognitive ability) and linguistic factors (types of linguistic errors, e.g., morphology, syntax, spelling and, punctuation) (Lee & Du, 2021; Moser, 2020; Nowbakht & Olive, 2021).

Second, through the analysis of dual-map overlay, co-citation, and keyword co-occurrence, the results revealed that, despite first being introduced as a linguistic concept, WCF research has spread to encompass a wide range of disciplines (e.g., computer technology, cognitive science, and psychology). Computer-assisted language learning has brought new forms of language learning, bringing AWE into focus (Barrot, 2023; Cheng, 2017). The computer corpus's establishment and perfection for enhancing AWE's ability may be the future research topic in WCF. Moreover, cognitive science has led researchers to pay increasingly more attention to the impact of WCF on L2 learners' psychological activities, with research represented by the academic emotions evoked by WCF emerging as a new research direction (Han & Hyland, 2019), which also provides a new compensation mechanism for the efficiency enhancement of WCF acting on L2 learners' writing proficiency. As *Computer Assisted Language Learning*, *Language Learning Technology*, and *Frontiers in Psychology* have become the Top 10 journals with numerous articles in WCF, the interdisciplinary research trend of WCF has gradually become mainstream in the field. The interdisciplinary research provides insight into the relationship between language and the brain, generating empirical support for the research theme of how, from the perspective of WCF, internal mechanisms and external environmental factors play a role in language acquisition.

Third, a geospatial analysis of publications was conducted to explore the dominant forces in WCF research and the extent of research collaboration among countries or regions. This study found that the United States and China can be considered the dominant forces in WCF research, for they have the most publications and the highest H-indices. These findings support Mao et al.'s (2023) review of WCF in the L2 writing context, which pointed out that the United States, China, and other countries and regions led the development of WCF research. The first three in terms of collaboration rate were found to be New Zealand (75.86%), South Korea (63.16%), and Australia (54.84%), all countries with complex and diverse linguistic environments characterized by multiple language variants. For instance, Shintani et al.'s (2014) article comparing two types of WCF (i.e., direct corrective feedback and metalinguistic explanation) has a high number of citations (more than 100) from collaborating scholars with Singaporean, New Zealander, and Japanese backgrounds. The data show not only that WCF has gained significant attention from leading research institutions, but also that it has fostered cross-cultural collaboration.

Fourth, the present study explored the main themes and hotspots of WCF research by conducting co-citation and citation burst analysis. The complexity of WCF as an independent academic concept can be reflected in its research topics. Cluster #0 (error correction), Cluster #4 (grammar correction), and Cluster #6 (metalinguistic awareness) indicate the establishment and development process of the WCF internal construct framework. The emphasis on meta-linguistic awareness in WCF research reflects the fact that the concept of WCF has expanded from grammar correction to lexical, syntactic, and more comprehensive aspects of language use. This expansion

has occurred because meta-linguistic WCF stimulates deep internal processing and facilitates the transformation of declarative knowledge into procedural knowledge to help learners summarize and analyze language knowledge (Bitchener & Knoch, 2010). At the same time, the various stakeholders involved in WCF have become the focus of efforts to integrate WCF into the whole ecology of language teaching and learning. The “student” identity in WCF research has gradually diversified in this process. Since students are the recipients of WCF, researchers are interested in how different individual factors interact with the external environment to influence learners’ understanding and adoption of WCF (Han & Hyland, 2015; Hyland, 2013; Koltovskaia, 2020; Zheng & Yu, 2018). Researchers also find that the identity of WCF providers is not limited to more advanced language users (e.g., L2 teachers, native speakers). L2 learners with similar language proficiency levels can also provide each other with accurate WCF through collaborative learning (Anderson et al., 2010; Elola & Oskoz, 2010), making collaborative writing a new research topic for WCF (cluster #5, collaborative writing).

Last, during periods of theoretical exploration and development, most WCF studies have examined the impact of WCF on language skill development in the L2 teaching context, ignoring individual differences among learners (Ellis, 2010). This emphasis on the focus is also the primary reason why many previous studies have utilized controlled experiments. These experiments aim to compare and observe the short- or long-term changes in writing ability between learners who received WCF and those who did not. Furthermore, they strive to quantitatively analyze the results through the application of mathematical statistics. However, the statistical method of quantifying the mean values of the research groups erases the differences in individual variances between participants, and as the focus of research gradually shifts to the influencing factors of WCF, exploratory qualitative research becomes a new trend. The trend of qualitative research in WCF research is reflected in two main aspects: the application of qualitative research methods represented by classroom observation, interviews, and the increase of case studies. Cluster #10 follow-up interview in the keyword co-occurrence analysis is a good indication of the emerging trend of qualitative research or mixed methods adopted in WCF research (Chen, 2022; Han & Hyland, 2019; Kim et al., 2020; Shintani, 2016). In addition, case studies matched with qualitative studies are more conducive to in-depth analysis of individual differences (Mao & Lee, 2020; Zheng & Yu, 2018). Cluster #2 student engagement in co-citation analysis indicates that current studies tend to conduct detailed and in-depth exploration of different stakeholders involved in WCF (Koltovskaia, 2020; Zheng & Hyland, 2018). Based on a solid theoretical foundation, WCF research has moved beyond the theoretical validation period, and exploring new directions in this field is receiving increasing attention.

Conclusion

This study presented a retrospective review of 497 articles and review articles published in the field of WCF from 1987 to 2022 in WoS. The existing WCF research was extensive and multidisciplinary in nature, and this study systematically reviewed the leading research threads in this field to inspire subsequent research. The core of the academic discussion was gradually refined from whether WCF was effective to which type of WCF was more effective. Moreover, with the impact of novel technologies and perspectives, researchers have gradually focused on automatic WCF closely related to computer science and paid more attention to the subjective motivation of WCF stakeholders. The factors influencing the effectiveness of WCF and its impact on language learners’ mental activities and emotions emerged as a new research trend under the

interdisciplinary perspective of sociology and cognitive science. However, this study still has some limitations. First, as a linguistics concept, WCF has distinct social science attributes. To ensure data accuracy, this study's data set was limited to SSCI and AHCI, and relevant literature included in other databases (e.g., SCI and ESCI) may be ignored. Second, to provide a more accurate analysis of the most productive and influential journals in WCF research, only articles and review articles published in journals were considered in this study; conference articles, which can also represent the latest trends in the field, were not included in the data set. Future studies could consider a more comprehensive visual analysis of research in the field of WCF by expanding the database.

About the authors

Dr. Xuan Wang is currently Assistant Professor at the School of Foreign Studies, Northwestern Polytechnical University, China. She completed her PhD from the University of Sydney in 2018 and her research interest is second language vocabulary development, language testing and teaching, and language policy and planning.

ORCID: <https://orcid.org/0000-0002-5741-0065>

Jingying Zuo is a Master student in applied linguistics at School of Foreign Studies, Northwestern Polytechnical University. Her areas of interest include nonverbal communication in the second language class, language pedagogy, and tacit knowledge in education.

ORCID: <https://orcid.org/0000-0001-7813-5253>

Xinyi Wang is an undergraduate student in English major at School of Foreign Studies, Northwestern Polytechnical University. Her research interests are Applied Linguistics, Teaching English to Speakers of Other Languages (TESOL).

ORCID: <https://orcid.org/0009-0007-2548-1161>

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Appendices

Appendix A

Supplementary Table A. Most-cited publications of WCF from 1987–2022

Rank	Publications: Author (Year) Title	Cites
1	Truscott, J. (1996). The case against grammar correction in L2 writing classes.	606
2	Chandler, J. (2003). The efficacy of various kinds of error feedback for improvement in the accuracy and fluency of L2 student writing.	409
3	Sheen, Y. (2007). The effect of focused written corrective feedback and language aptitude on ESL learners' acquisition of articles.	320
4	Bitchener, J. (2008). Evidence in support of written corrective feedback.	313
5	Bitchener, J., Young, S., & Cameron, D. (2005). The effect of different types of corrective feedback on ESL student writing.	282
6	Ellis, R., Sheen, Y., Murakami, M., & Takashima, H. (2008). The effects of focused and unfocused written corrective feedback in an English as a foreign language context.	266
7	Truscott, J. (2007). The effect of error correction on learners' ability to write accurately.	254
8	Ferris, D. (2004). The "grammar correction" debate in L2 writing: Where are we, and where do we go from here? (And what do we do in the meantime...?)	247
9	Ellis, R. (2009). A typology of written corrective feedback types.	241
10	Ferris, D. (2010). Second language writing research and written corrective feedback in SLA intersections and practical applications.	237

Appendix B

Supplementary Table B. Top 10 productive countries (regions) for WCF research

Country /Region	Paper quantity	Times cited	H	Main institutions	Keywords
USA	138	5,370	38	University System of Georgia, University of California System, Brigham Young University	written corrective feedback (49), error correction (37), acquisition (31), corrective feedback (29), accuracy (26), English (19), student (18), grammar correction (18), fluency (13), efficacy (10), form (9)
China	123	2,527	26	University of Macau, Chinese University of Hong Kong, Education University of Hong Kong	written corrective feedback (70), accuracy (30), L2 writing (25), corrective feedback (23), teacher feedback (23), student (23), student engagement (22), perception (20), error correction (20), acquisition (16)
Australia	31	1,232	13	University of Melbourne, University of Queensland	accuracy (4), error (3), revision (2), acquisition (2), grammar correction (1), written accuracy (1), collaborative writing (1), feedback (1), pair work (1), error correction (2)
Spain	31	312	10	University of Murcia, Universidad Publica De Navarra, University of Basque Country	written corrective feedback (16), output (13), error correction (10), corrective feedback (9), student (8), attention (7), revision (7), accuracy (7), grammar correction (4), reformulation (4)
New Zealand	29	2,398	19	University of Auckland, Auckland University of Technology, Victoria University Wellington	error (7), grammar correction (3), error correction (6), acquisition (5), corrective feedback (3), accuracy (2), written corrective feedback (3), capacity (1), task complexity (3), comprehensive written corrective feedback (2)
Canada	27	357	8	University of Victoria, Simon Fraser University	accuracy (7), error correction (2), feedback on form (1), error (3), L2 teacher training

					(1), awareness (1), grammar-correction (2), students (2)
England	26	376	9	The University of Exeter, The University of London, Manchester Metropolitan University	composing processes (1), instruction (1), metalinguistic awareness revision activities (1), error-correction (3), grammar correction (1), intrinsic motivation (1), article use (1), explicit (1), written corrective feedback (4), feedback (2), learner engagement (2)
Iran	25	208	8	Islamic Azad University, Shiraz University, University of Isfahan	complexity (1), error (1), fluency (1), modified output (2), corrective feedback (5), recasts (2), written corrective feedback (7), accuracy (1), computer-mediated feedback (1), acquisition (3)
South Korea	19	243	8	Korea Advanced Institute of Science Technology, Yonsei University	form-focused instruction (1), modified output (1), written corrective feedback (4), corrective feedback (1), integrated reading-to-write task (1), recasts (1), accuracy (3), collaborative writing (3), error correction (1)
Japan	17	713	10	Miyagi University Education, Akita International University, Kansai University	error (1), grammar (1), focused/unfocused feedback (1), corrective feedback (2), attention (1), feedback (3), accuracy (2), classroom assessment (1), revision (2), acquisition (2), writing (2)