**Supplementary Material A1:** Discontinued journals from Scopus or those they are categorized as predatory.

* *Asian EFL journal*
* *Asian ESP Journal*
* *Journal of Language Teaching and Research*
* *Theory and Practice in Language Studies*
* *English Language Teaching*
* *International Journal of Applied Linguistics and English Literature*
* *World Journal of English Language*
* *International Journal of Innovation Creativity and Change*
* *World Journal of Educational Technology*
* *Cypriot Journal of Educational Sciences*
* *Journal of Language and Linguistics Studies*

**Supplementary Material A2:**

**CALL-core journals:**

*CALICO, ReCALL, Computer Assisted Language Learning, and LL&T.*

**Non-core CALL journals:**

*CALL-EJ, JALT CALL, Teaching English with Technology (TEwT), International Journal of Computer Assisted Language Learning and Teaching.*

**Supplementary Material A3:**

*Computers & Education, British Journal of Educational Technology, Educational Technology Research & Development, Journal of Educational Computing Research, Interactive Learning Environments, Educational Technology and Society, Journal of Computer Assisted Learning, Education and Information Technologies, Australasian Journal of Educational Technology, International Journal of Educational Technology in Higher Education, Journal of Computers in Education, Turkish Online Journal of Educational Technology, International Journal of Computer-Supported Collaborative Learning, Behaviour and Information Technology, Technology, Pedagogy and Education, Computers and Education: Artificial Intelligence.*

**Supplementary Material B1: Adapted from Lim and Aryadoust (2022) with slight modifications (we added the terms pronunciation and spelling)**

Edu Tech

TITLE-ABS-KEY ( reading ) AND EXACTSRCTITLE ( computers AND education ) OR EXACTSRCTITLE ( british AND journal AND of AND educational AND technology ) OR EXACTSRCTITLE ( journal AND of AND computer AND assisted AND learning ) OR EXACTSRCTITLE ( journal AND of AND educational AND computing AND research ) OR EXACTSRCTITLE ( journal AND of AND educational AND technology AND society ) OR EXACTSRCTITLE ( educational AND technology AND research AND development ) OR EXACTSRCTITLE ( interactive AND learning AND environments ) OR EXACTSRCTITLE ( international AND journal AND of AND educational AND technology AND in AND higher AND education ) OR EXACTSRCTITLE ( australasian AND journal AND of AND educational AND technology ) OR EXACTSRCTITLE (Education and Information Technologies) OR EXACTSRCTITLE (International Journal of Educational Technology in Higher Education) OR EXACTSRCTITLE (Journal of Computers in Education) OR EXACTSRCTITLE (Turkish Online Journal of Educational Technology) OR EXACTSRCTITLE (International Journal of Computer-Supported Collaborative Learning) OR EXACTSRCTITLE (Behaviour and Information Technology) OR EXACTSRCTITLE (Technology, Pedagogy and Education) OR EXACTSRCTITLE (Computers and Education: Artificial Intelligence) AND ( LIMIT-TO ( SRCTYPE,"j" ) ) AND ( LIMIT-TO ( DOCTYPE,"ar" ) OR LIMIT-TO ( DOCTYPE,"re" ) ) AND ( EXCLUDE ( PUBYEAR,2022) ) AND ( LIMIT-TO ( LANGUAGE,"English" ) )

TITLE-ABS-KEY ( listening ) AND EXACTSRCTITLE ( computers AND education ) OR EXACTSRCTITLE ( british AND journal AND of AND educational AND technology ) OR EXACTSRCTITLE ( journal AND of AND computer AND assisted AND learning ) OR EXACTSRCTITLE ( journal AND of AND educational AND computing AND research ) OR EXACTSRCTITLE ( journal AND of AND educational AND technology AND society ) OR EXACTSRCTITLE ( educational AND technology AND research AND development ) OR EXACTSRCTITLE ( interactive AND learning AND environments ) OR EXACTSRCTITLE ( international AND journal AND of AND educational AND technology AND in AND higher AND education ) OR EXACTSRCTITLE ( australasian AND journal AND of AND educational AND technology ) OR EXACTSRCTITLE (Education and Information Technologies) OR EXACTSRCTITLE (International Journal of Educational Technology in Higher Education) OR EXACTSRCTITLE (Journal of Computers in Education) OR EXACTSRCTITLE (Turkish Online Journal of Educational Technology) OR EXACTSRCTITLE (International Journal of Computer-Supported Collaborative Learning) OR EXACTSRCTITLE (Behaviour and Information Technology) OR EXACTSRCTITLE (Technology, Pedagogy and Education) OR EXACTSRCTITLE (Computers and Education: Artificial Intelligence) AND ( LIMIT-TO ( SRCTYPE,"j" ) ) AND ( LIMIT-TO ( DOCTYPE,"ar" ) OR LIMIT-TO ( DOCTYPE,"re" ) ) AND ( EXCLUDE ( PUBYEAR,2022) ) AND ( LIMIT-TO ( LANGUAGE,"English" ) )

TITLE-ABS-KEY ( speaking ) AND EXACTSRCTITLE ( computers AND education ) OR EXACTSRCTITLE ( british AND journal AND of AND educational AND technology ) OR EXACTSRCTITLE ( journal AND of AND computer AND assisted AND learning ) OR EXACTSRCTITLE ( journal AND of AND educational AND computing AND research ) OR EXACTSRCTITLE ( journal AND of AND educational AND technology AND society ) OR EXACTSRCTITLE ( educational AND technology AND research AND development ) OR EXACTSRCTITLE ( interactive AND learning AND environments ) OR EXACTSRCTITLE ( international AND journal AND of AND educational AND technology AND in AND higher AND education ) OR EXACTSRCTITLE ( australasian AND journal AND of AND educational AND technology ) OR EXACTSRCTITLE (Education and Information Technologies) OR EXACTSRCTITLE (International Journal of Educational Technology in Higher Education) OR EXACTSRCTITLE (Journal of Computers in Education) OR EXACTSRCTITLE (Turkish Online Journal of Educational Technology) OR EXACTSRCTITLE (International Journal of Computer-Supported Collaborative Learning) OR EXACTSRCTITLE (Behaviour and Information Technology) OR EXACTSRCTITLE (Technology, Pedagogy and Education) OR EXACTSRCTITLE (Computers and Education: Artificial Intelligence) AND ( LIMIT-TO ( SRCTYPE,"j" ) ) AND ( LIMIT-TO ( DOCTYPE,"ar" ) OR LIMIT-TO ( DOCTYPE,"re" ) ) AND ( EXCLUDE ( PUBYEAR,2022) ) AND ( LIMIT-TO ( LANGUAGE,"English" ) )

TITLE-ABS-KEY ( writing ) AND EXACTSRCTITLE ( computers AND education ) OR EXACTSRCTITLE ( british AND journal AND of AND educational AND technology ) OR EXACTSRCTITLE ( journal AND of AND computer AND assisted AND learning ) OR EXACTSRCTITLE ( journal AND of AND educational AND computing AND research ) OR EXACTSRCTITLE ( journal AND of AND educational AND technology AND society ) OR EXACTSRCTITLE ( educational AND technology AND research AND development ) OR EXACTSRCTITLE ( interactive AND learning AND environments ) OR EXACTSRCTITLE ( international AND journal AND of AND educational AND technology AND in AND higher AND education ) OR EXACTSRCTITLE ( australasian AND journal AND of AND educational AND technology ) OR EXACTSRCTITLE (Education and Information Technologies) OR EXACTSRCTITLE (International Journal of Educational Technology in Higher Education) OR EXACTSRCTITLE (Journal of Computers in Education) OR EXACTSRCTITLE (Turkish Online Journal of Educational Technology) OR EXACTSRCTITLE (International Journal of Computer-Supported Collaborative Learning) OR EXACTSRCTITLE (Behaviour and Information Technology) OR EXACTSRCTITLE (Technology, Pedagogy and Education) OR EXACTSRCTITLE (Computers and Education: Artificial Intelligence) AND ( LIMIT-TO ( SRCTYPE,"j" ) ) AND ( LIMIT-TO ( DOCTYPE,"ar" ) OR LIMIT-TO ( DOCTYPE,"re" ) ) AND ( EXCLUDE ( PUBYEAR,2022) ) AND ( LIMIT-TO ( LANGUAGE,"English" ) )

TITLE-ABS-KEY ( grammar ) AND EXACTSRCTITLE ( computers AND education ) OR EXACTSRCTITLE ( british AND journal AND of AND educational AND technology ) OR EXACTSRCTITLE ( journal AND of AND computer AND assisted AND learning ) OR EXACTSRCTITLE ( journal AND of AND educational AND computing AND research ) OR EXACTSRCTITLE ( journal AND of AND educational AND technology AND society ) OR EXACTSRCTITLE ( educational AND technology AND research AND development ) OR EXACTSRCTITLE ( interactive AND learning AND environments ) OR EXACTSRCTITLE ( international AND journal AND of AND educational AND technology AND in AND higher AND education ) OR EXACTSRCTITLE ( australasian AND journal AND of AND educational AND technology ) OR EXACTSRCTITLE (Education and Information Technologies) OR EXACTSRCTITLE (International Journal of Educational Technology in Higher Education) OR EXACTSRCTITLE (Journal of Computers in Education) OR EXACTSRCTITLE (Turkish Online Journal of Educational Technology) OR EXACTSRCTITLE (International Journal of Computer-Supported Collaborative Learning) OR EXACTSRCTITLE (Behaviour and Information Technology) OR EXACTSRCTITLE (Technology, Pedagogy and Education) OR EXACTSRCTITLE (Computers and Education: Artificial Intelligence) AND ( LIMIT-TO ( SRCTYPE,"j" ) ) AND ( LIMIT-TO ( DOCTYPE,"ar" ) OR LIMIT-TO ( DOCTYPE,"re" ) ) AND ( EXCLUDE ( PUBYEAR,2022) ) AND ( LIMIT-TO ( LANGUAGE,"English" ) )

TITLE-ABS-KEY ( vocabulary ) AND EXACTSRCTITLE ( computers AND education ) OR EXACTSRCTITLE ( british AND journal AND of AND educational AND technology ) OR EXACTSRCTITLE ( journal AND of AND computer AND assisted AND learning ) OR EXACTSRCTITLE ( journal AND of AND educational AND computing AND research ) OR EXACTSRCTITLE ( journal AND of AND educational AND technology AND society ) OR EXACTSRCTITLE ( educational AND technology AND research AND development ) OR EXACTSRCTITLE ( interactive AND learning AND environments ) OR EXACTSRCTITLE ( international AND journal AND of AND educational AND technology AND in AND higher AND education ) OR EXACTSRCTITLE ( australasian AND journal AND of AND educational AND technology ) OR EXACTSRCTITLE (Education and Information Technologies) OR EXACTSRCTITLE (International Journal of Educational Technology in Higher Education) OR EXACTSRCTITLE (Journal of Computers in Education) OR EXACTSRCTITLE (Turkish Online Journal of Educational Technology) OR EXACTSRCTITLE (International Journal of Computer-Supported Collaborative Learning) OR EXACTSRCTITLE (Behaviour and Information Technology) OR EXACTSRCTITLE (Technology, Pedagogy and Education) OR EXACTSRCTITLE (Computers and Education: Artificial Intelligence) AND ( LIMIT-TO ( SRCTYPE,"j" ) ) AND ( LIMIT-TO ( DOCTYPE,"ar" ) OR LIMIT-TO ( DOCTYPE,"re" ) ) AND ( EXCLUDE ( PUBYEAR,2022) ) AND ( LIMIT-TO ( LANGUAGE,"English" ) )

TITLE-ABS-KEY ( pronunciation ) AND EXACTSRCTITLE ( computers AND education ) OR EXACTSRCTITLE ( british AND journal AND of AND educational AND technology ) OR EXACTSRCTITLE ( journal AND of AND computer AND assisted AND learning ) OR EXACTSRCTITLE ( journal AND of AND educational AND computing AND research ) OR EXACTSRCTITLE ( journal AND of AND educational AND technology AND society ) OR EXACTSRCTITLE ( educational AND technology AND research AND development ) OR EXACTSRCTITLE ( interactive AND learning AND environments ) OR EXACTSRCTITLE ( international AND journal AND of AND educational AND technology AND in AND higher AND education ) OR EXACTSRCTITLE ( australasian AND journal AND of AND educational AND technology ) OR EXACTSRCTITLE (Education and Information Technologies) OR EXACTSRCTITLE (International Journal of Educational Technology in Higher Education) OR EXACTSRCTITLE (Journal of Computers in Education) OR EXACTSRCTITLE (Turkish Online Journal of Educational Technology) OR EXACTSRCTITLE (International Journal of Computer-Supported Collaborative Learning) OR EXACTSRCTITLE (Behaviour and Information Technology) OR EXACTSRCTITLE (Technology, Pedagogy and Education) OR EXACTSRCTITLE (Computers and Education: Artificial Intelligence) AND ( LIMIT-TO ( SRCTYPE,"j" ) ) AND ( LIMIT-TO ( DOCTYPE,"ar" ) OR LIMIT-TO ( DOCTYPE,"re" ) ) AND ( EXCLUDE ( PUBYEAR,2022) ) AND ( LIMIT-TO ( LANGUAGE,"English" ) )

TITLE-ABS-KEY ( spelling ) AND EXACTSRCTITLE ( computers AND education ) OR EXACTSRCTITLE ( british AND journal AND of AND educational AND technology ) OR EXACTSRCTITLE ( journal AND of AND computer AND assisted AND learning ) OR EXACTSRCTITLE ( journal AND of AND educational AND computing AND research ) OR EXACTSRCTITLE ( journal AND of AND educational AND technology AND society ) OR EXACTSRCTITLE ( educational AND technology AND research AND development ) OR EXACTSRCTITLE ( interactive AND learning AND environments ) OR EXACTSRCTITLE ( international AND journal AND of AND educational AND technology AND in AND higher AND education ) OR EXACTSRCTITLE ( australasian AND journal AND of AND educational AND technology ) OR EXACTSRCTITLE (Education and Information Technologies) OR EXACTSRCTITLE (International Journal of Educational Technology in Higher Education) OR EXACTSRCTITLE (Journal of Computers in Education) OR EXACTSRCTITLE (Turkish Online Journal of Educational Technology) OR EXACTSRCTITLE (International Journal of Computer-Supported Collaborative Learning) OR EXACTSRCTITLE (Behaviour and Information Technology) OR EXACTSRCTITLE (Technology, Pedagogy and Education) OR EXACTSRCTITLE (Computers and Education: Artificial Intelligence) AND ( LIMIT-TO ( SRCTYPE,"j" ) ) AND ( LIMIT-TO ( DOCTYPE,"ar" ) OR LIMIT-TO ( DOCTYPE,"re" ) ) AND ( EXCLUDE ( PUBYEAR,2022) ) AND ( LIMIT-TO ( LANGUAGE,"English" ) )

**Supplementary Material B2: Applied Linguistics and Social Sciences (8,977). Adopted from Chen et al. (2021)**

( "spoc" OR "Internet" OR "twitter" OR "Google Docs" OR "WhatsApp" OR "Skype" OR "wearable device" OR "hyperlink\*" OR "smartphone\*" OR "game" OR "automatic speech recognition" OR "speech-to-text recognition" OR "clicker" OR "smart watch" OR "smartwatch" OR "e-portfolio" OR "social network" OR "online communit\*" OR "e-book" OR "intelligent tutoring system" OR "multimedia" OR "video" OR "ipod" OR "digital" OR "web 2.0" OR "augmented reality" OR "wechat" OR "facebook" OR "flipped classroom" OR "moodle" OR "MOOCS" OR "blackboard" OR "google doc, google classroom, google drive" OR "skype" OR "e-learning" OR "self-instruction program" OR "programmed learning" OR "blended learning" OR "web based" OR "web-based" OR "machine learning" OR "online" OR "educational software" OR "virtual reality" OR "blog" OR "chat" OR "computer" OR "technology" OR "electronic discussion groups" OR "interactive whiteboard" OR "iPad" OR "Laptop" OR "messaging" OR "microblog" OR "micro-blog" OR "microblogging" OR "mobile" OR "padlet" OR "social media" OR "tablet" OR "wiki" OR "ubiquitous" ) AND ( "literacy learning" OR "language learning" OR "second language" ) AND ( LIMIT-TO ( SRCTYPE , "j" ) ) AND ( LIMIT-TO ( DOCTYPE , "ar" ) ) AND ( LIMIT-TO ( SUBJAREA , "SOCI" ) OR LIMIT-TO ( SUBJAREA , "ARTS" ) ) AND ( EXCLUDE ( PUBYEAR , 2022 )

**Supplementary Material C1: Inconsistencies in authors’ names**



**Supplementary Material C2: Inconsistencies in sources of publications**



**Supplementary Material C3: A sample of inconsistencies in study titles**

**Supplementary Material C4: Inconsistencies in authors’ keywords**



**Supplementary Material D: Data analysis procedure**

In our analysis, we employed CiteSpace software 6.1 R3 Advanced (Chen, 2006) to perform a DCA over references. Additionally, we used VOSviewer (Van Eck & Waltman, 2010) to examine authors’ keyword co-occurrences, as well as the co-citation and production of publication sources. To calculate the H-index for sources of publication, we made use of Microsoft Excel. Our analysis relied on several structural and temporal metrics to identify co-citations, including Modularity effect (Q-index), silhouette scores, and betweenness centrality as structural examples, with citation bursts and sigma representing temporal metrics (Chen, 2017). Modularity Q score gauges the interrelationship within a network, ascertaining whether its elements are tightly or loosely grouped (Newman, 2006). Silhouette score quantifies the uniformity and similarity within a cluster (Rousseeuw, 1987), with higher scores indicating greater homogeneity. The term “burst” signals abrupt and significant spikes in citation frequency, reflecting intensified scholarly focus on a specific topic or document (Chen, 2011; Aryadoust, 2020). (Betweenness) Centrality ascertains node positions within a network, with nodes of higher centrality typically located between correlated clusters (Brandes, 2001). Sigma score denotes the scientific originality of a citation (Chen et al., 2012).

In our analysis, we utilized CiteSpace to identify and visualize research clusters within the field of CALL. Specifically, CiteSpace created clusters based on the frequency of words found within the titles, abstracts, and authors’ keywords of the research articles. The software also provided a timeline visualization of these research clusters, allowing us to track their emergence and evolution. To further examine the trends over time, we implemented a time slicing technique with a one-year interval per slice. Drawing on Solmi et al. (2022), we chose to investigate hotspot research within the most recent five-year period (2017-2021). When naming the clusters, we opted to use titles (T) labeling, as this approach best represented the cluster labels. Additionally, we employed the User-Defined Cluster Labels feature within CiteSpace to manually overwrite certain labels where the generated labels were found to be insufficiently indicative (Aryadoust & Ang, 2021). For instance, clusters #7 and #8 within the 1987-2021 timeframe were originally labeled as *Teaching German* and *assisted-language* by CiteSpace. Upon a detailed review of the contents within these clusters, we manually renamed them to *Foreign Language* and *CALL* to more accurately reflect their thematic focus.

In our study focusing on the hotspot areas of CALL research and the trending issues over time, we have carefully selected a range of tools and methods that best suit our analytical needs. For analyzing word-co-occurrences to illustrate the most prevalent topics in CALL research, we used VOSviewer. Our decision to utilize VOSviewer was informed by its efficacy in visualizing data nodes for keywords, which we found to be more effective than CiteSpace for our specific requirements. Additionally, a significant factor influencing our choice to use VOSviewer instead of CiteSpace was the handling of various file formats. Specifically, VOSviewer’s ability to work with CSV (Comma-Separated Values) files offers a considerable advantage in data refinement. CSV files, being text-based, have a structure that allows for easier identification and rectification of errors in keywords especially synonymous words. To further refine our substantial dataset, we opted to filter authors’ keywords using a CSV file. This method allowed us to precisely limit the filter to the authors’ keywords column, thereby enhancing the accuracy of our dataset refinement process. Additionally, we utilized an Excel sheet for manually identifying the number of articles per source of publication.

Given that our investigation is centered on identifying the hotspot areas of CALL research[[1]](#endnote-2) and understanding the evolving trends, we have strategically limited our analysis to focus on key areas including cluster analysis (timeline view), citation bursts, keyword analyses and co-occurrences, and the productivity and co-citation frequency of authors and journals.

**Supplementary Material E1: Clusters’ major citing articles and top 3 cited references in the 1987–2021 time frame**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Cluster ID | Citing article | The major citing article | Coverage | 1st Most co-cited reference | Frequency | 2nd Most co-cited reference | Frequency | 3rd Most co-cited reference | Frequency |
| #0 | 299 | Vurdien (2017) | 22 | Nation (2001) | 161 | Golonka et al. (2014) | 77 | Thornton and Houser (2005) | 67 |
| #1 | 161 | Fischer (2007) | 20 | Levy (1997) | 89 | Krashen (1985) | 79 | Oxford (1990) | 73 |
| #2 | 252 | Yilmaz and Granena (2010) | 21 | Vygotsky and Cole (1978) | 338 | Ellis (2003) | 99 | Long (1996) | 79 |
| #3 | 146 | Shin (2006) | 18 | Kern (1995) | 127 | Warschauer (1996) | 93 | Chun (1994) | 81 |
| #4 | 125 | Tai (2015) | 9 | Lave and Wenger (1991) | 72 | Byram (1997) | 65 | Levy and Stockwell (2006) | 58 |
| #5 | 66 | Smart (2014) | 12 | Schmidt (1990) | 125 | Johns (1991) | 26 | Hyunsook (2008) | 25 |
| #6 | 21 | Eskenazi (2013) | 9 | Krashen (1982) | 56 | Braun and Clarke (2006) | 5 | Kenning and Kenning (1990) | 4 |
| #7 | 7 | Möllering (2001) | 10 | Biber (1988) | 9 | Swales (1990) | 6 | Halliday and Hasan (1976) | 5 |
| #8 | 4 | Chapelle (1990) | 5 | Carter and McCarthy (1988) | 4 | Allwright (1988) | 3 | Aitchison (1987) | 3 |
| #10 | 3 | Chen and Hsu (2008) | 6 | Heift and Nicholson (2001) | 6 | Lin and Hsieh (2001) | 3 | Cui and Bull (2005) | 3 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Cluster ID | Citing article | The major citing article | Coverage | 1st Most co-cited reference | Frequency | 2nd Most co-cited reference | Frequency | 3rd Most co-cited reference | Frequency |
| #0 | 38 | Lee (2019b) | 16 | Burston (2015) | 22 | Burston (2014) | 20 | Shadiev et al. (2017) | 15 |
| #1 | 37 | H. J. H. Chen et al. (2021) | 5 | Golonka et al. (2014) | 16 | Miles et al. (2014) | 10 | Sundqvist (2019) | 9 |
| #2 | 25 | Fathi and Rahimi (2022) | 9 | Hung (2015) | 29 | Bergmann and Sams (2012) | 24 | Chen-Hsieh et al. (2017) | 20 |
| #3 | 18 | Chen (2018) | 7 | Lin and Lan (2015) | 15 | Jauregi et al. (2011) | 10 | Balaman and Sert (2017) | 6 |
| #4 | 27 | Rahimi and Fathi (2021) | 7 | Elola and Oskoz (2017) | 12 | Storch (2013) | 11 | Plonsky and Oswald (2014) | 10 |
| #5 | 23 | Bahari and Salimi (2021) | 7 | Stockwell (2010) | 11 | Blake (2016) | 10 | Wang and Smith (2013) | 9 |
| #6 | 19 | Lee (2019a) | 17 | Sundqvist and Wikström (2015) | 11 | Lai and Mingyue (2011) | 11 | Reinders and Wattana (2015) | 9 |
| #7 | 22 | Vurdien (2017) | 9 | Wang and Vasquez (2012) | 15 | Kessler et al. (2012) | 14 | Kern (2014) | 13 |
| #8 | 16 | Brudermann et al. (2021) | 5 | Stevenson and Phakiti (2014) | 11 | Ziegler (2016) | 9 | Wilson and Czik (2016) | 9 |
| #9 | 30 | Lee (2017) | 8 | Golonka et al. (2014) | 63 | Lee (2016) | 16 | Vurdien (2013) | 6 |
| #10 | 8 | Ballance (2017) | 7 | Boulton and Cobb (2017) | 20 | Boulton (2010) | 6 | Reppen (2010) | 5 |
| #11 | 11 | Hsu (2018) | 4 | Winke et al. (2013) | 9 | Schenker (2012) | 9 | Benson (2015) | 8 |
| #12 | 8 | Tsai et al. (2017) | 5 | Smith et al. (2013) | 8 | Berns et al. (2013) | 6 | Liu and Chu (2010) | 5 |

**Supplementary Material E2: Clusters’ major citing articles and top 3 cited references in the 2017–2021 time frame**

**Supplementary Material F: Top Co-cited journals with at least 600 citations of a source**

|  |  |  |
| --- | --- | --- |
| Source | Co-Citation Frequency | Total Link Strength |
| Language Learning & Technology | 5400 | 83125 |
| Computer Assisted Language Learning | 5389 | 81607 |
| Computers & Education | 3971 | 45049 |
| CALICO Journal | 3457 | 53125 |
| The Modern Language Journal | 3433 | 58292 |
| System | 3187 | 52088 |
| ReCALL | 3175 | 49896 |
| Tesol Quarterly | 2092 | 32208 |
| Language Learning | 2031 | 39664 |
| Applied Linguistics | 1778 | 31240 |
| Studies in Second Language Acquisition | 1636 | 33862 |
| Foreign Language Annals | 1473 | 24014 |
| Journal of Second Language Writing | 1421 | 22444 |
| British Journal of Educational Technology | 1336 | 19664 |
| Journal of Educational Psychology | 1199 | 11688 |
| Computers in Human Behavior | 1167 | 15636 |
| Journal of Computer Assisted Learning | 1020 | 14295 |
| ELT Journal | 955 | 13424 |
| Educational Technology & Society | 947 | 13604 |
| Language Teaching Research | 850 | 16958 |
| Language Teaching | 738 | 12603 |
| Educational Technology Research and Development | 612 | 8506 |

**Supplementary Material G1: Top 10 references with the highest (betweenness) centrality and sigma scores 1980–2021 time frame**

|  |  |  |
| --- | --- | --- |
|  | Reference | Cluster ID |
| Centrality |
| 0.30 | Vygotsky and Cole (1978) | 2 |
| 0.10 | Levy (1997) | 1 |
| 0.09 | Krashen (1982) | 6 |
| 0.08 | Schmidt (1990) | 5 |
| 0.08 | Nation (2001) | 0 |
| 0.07 | Kern (1995) | 3 |
| 0.05 | Oxford (1990) | 1 |
| 0.04 | Warschauer (1996) | 3 |
| 0.04 | Ellis (2003) | 2 |
| 0.04 | Chun (1994) | 3 |
| Sigma |
| 3.45 | Levy (1997) | 1 |
| 2.09 | Kern (1995) | 3 |
| 1.75 | Chun (1994) | 3 |
| 1.65 | Warschauer (1997) | 3 |
| 1.65 | Golonka et al. (2014) | 0 |
| 1.45 | Krashen (1982) | 6 |
| 1.28 | Oxford (1990) | 1 |
| 1.26 | Krashen (1985) | 1 |
| 1.23 | Warschauer (1996) | 3 |
| 1.23 | Levy and Stockwell (2006) | 4 |

**Supplementary Material G2: Top 10 references with the highest (betweenness) centrality and sigma scores 2017–2021 time frame**

|  |  |  |
| --- | --- | --- |
|  | Reference | Cluster ID |
| Centrality |
| 0.14 | Reinders and Wattana (2014) | 6 |
| 0.14 | Storch (2013) | 4 |
| 0.14 | Lee (2016) | 9 |
| 0.13 | Godwin-Jones (2019) | 1 |
| 0.12 | Hung (2015) | 2 |
| 0.11 | Burston (2014) | 0 |
| 0.11 | Boulton and Cobb (2017) | 10 |
| 0.10 | Li (2018) | 4 |
| 0.09 | Burston (2015) | 0 |
| 0.09 | Jauregi et al. (2011) | 3 |
| Sigma |
| 1.51 | Reinders and Wattana (2014) | 6 |
| 1.35 | Jauregi et al. (2011) | 3 |
| 1.32 | Stockwell (2010) | 5 |
| -1.17 | Lin et al. (2016) | 5 |
| 1.11 | Sundqvist and Wikström (2015) | 6 |
| 1.11 | Lee (2011) | 9 |
| 1.11 | Lai and Mingyue (2011) | 6 |
| 1.10 | Amiryousefi (2016) | 2 |
| 1.09 | Benson (2015) | 11 |
| 1.09 | Aydin and Yildiz (2014) | 7 |

**Supplementary Material H: Characteristics of clusters**

In this study, we identified 23 major clusters across two distinct timespans. Given the extensive nature of these clusters, a comprehensive analysis of each is not feasible. Instead, we focus on major clusters, particularly those sharing thematic similarities. By examining the highly cited references and impactful citing articles, we construct a thematic map to elucidate the primary foci within the CALL field.

1. Writing issue

This subject matter aligns closely with broader research in applied linguistics and particularly emphasizes the role of technology in augmenting various forms of feedback (Crosthwaite et al., 2022). In the first timespan from 1987 to 2021, two significant clusters emerged: Cluster #0, which focused on corrective feedback, and Cluster #2, which centered on Web-based Collaborative Writing. In the more recent timespan from 2017 to 2021, five clusters were identified: Cluster #2 on writing complexity and accuracy, Cluster #4 on the use of Google Docs, Cluster #8 on automated writing evaluation, and Cluster #9 on writing motivation. This suggests a diversification and deepening of research focus in technology-enhanced writing within CALL.

In the context of the entire research period, two clusters emerged that are pertinent to the field of L2 writing: written corrective feedback and web-based collaborative writing. Cluster #0, labelled as corrective feedback, was identified as a trending issue in the CALL field, featuring 245 cited articles and 299 citing articles. According to Zakaria and Aryadoust (2023), a research cluster exhibits strong thematic patterns between citing and cited articles. The most highly cited reference within this cluster is Nation’s (2001) book on learning vocabulary in another language, suggesting that the cluster’s focus is on vocabulary acquisition to enhance L2 writing. The most highly citing article is by Vurdien (2017), which concentrates on the use of MALL in vocabulary acquisition within L2 writing corrective feedback contexts.

The second cluster, #2, centers on Web-based Collaborative Writing and was identified in the first period (1987-2021). This cluster has gained attention due to its potential to help learners understand the organizational aspects of writing and acquire complex interactional skills (Abe, 2020). With a timespan from 1962 to 2019, the cluster comprises 204 cited references and 252 citing articles. It is theoretically anchored in the sociocultural theory proposed by Vygotsky and Cole (1978), emphasizing collaborative learning’s role in enhancing synchronous collaborative writing. The most highly citing article in this cluster is by Yilmaz and Granena (2010), which investigates the impact of different task types on students’ focus on linguistic forms in SCMC settings. This article cites 22 studies from the current cluster and is followed by Vurdien (2017), which also appears in the previous cluster for its focus on using wikis in a collaborative writing environment to enhance writing skills.

The period from 2017 to 2021 has seen a surge in scholarly interest within the CALL community, particularly focusing on the enhancement of writing skills. Four distinct clusters have been identified that explore cutting-edge technologies aimed at improving these skills. Two of these clusters are interrelated and concentrate on advancing L2 writing development. The first cluster, labeled as #2 “Writing Complexity Accuracy” by CiteSpace, features two prominent articles that explore the flipped classroom strategy. The article by Hung (2015) tops the list of cited references with the highest betweenness centrality and sigma scores, while the work by Chen Hsieh et al. (2017) ranks as the third most cited article. Bergmann and Sams' (2012) book on the flipped classroom is the second most cited work in this cluster. The article by Fathi and Rahimi (2022), which covers nine cited references, stands out as the most highly cited work in this cluster. This article investigates the impact of the flipped classroom on improving EFL writing performance in terms of complexity, accuracy, and fluency. Notably, all citing articles in this cluster were published between 2015 and 2021, indicating that this is a trending research issue that has gained traction in recent years.

In relation to Cluster #8, labelled as automated writing evaluation, the major citing article is by Brudermann et al. (2021), which delves into the effectiveness of various types of corrective feedback for refining EFL students’ writing errors. The most highly cited reference within this cluster is a systematic review by Stevenson & Phakiti (2014), followed by a conceptual article by Ziegler (2016). The latter emphasizes the benefits of corrective feedback for enhancing learners’ writing outcomes within the context of task-based language teaching. A third cluster pertinent to the writing domain is Cluster #9, labeled as writing evaluation. The top-cited reference here is an article by E. Golonka et al. (2014), which synthesizes CALL literature to identify the most effective technological devices for language learning. Other highly cited articles include Lee (2016), focusing on autonomous learning, and Vurdien (2013), which explores the use of blogging to improve L2 writing skills. Another cluster identified in the second period is Cluster #4, labeled as Google Docs. The top-cited article in this cluster is a conceptual paper by Elola & Oskoz (2017), offering frameworks to assist instructors in integrating social tools to foster L2 writing development in a digital age. Storch's (2013) book, focusing on collaborative writing, ranks as the second top-cited source, while Bahari & Salimi (2021) stands as the top citing article for this cluster.

2. MALL

In the timeline view of CALL research, two clusters related to MALL emerged as the most researched areas. MALL was identified as a hotspot, ranking second in the whole period under the label #1 cell phone (1998-2021) and first in the last five years as #0 mobile-assisted dynamic assessment (2012-2021). The first cluster, #1 cell phone, contained 219 cited references and 161 citing references. Top-cited works in this cluster include Levy’s 1997 book on CALL, Krashen's 1985 book on the input hypothesis, and Oxford’s 1990 book on language learning strategies, signifying that MALL is grounded in a robust theoretical framework. The top citing article in this cluster is Fischer (2007), which examined the effectiveness of tracking students’ usage of CALL software to gain insights into student behavior.

The second cluster, #0 mobile-assisted dynamic assessment, appearing in the most recent period, comprised 86 cited references and 97 citing references. The most cited work in this cluster is by Golonka et al. (2014), which synthesized the use of various mobile devices like tablet PCs, iPods, and smartphones in CALL studies. This work outlined potential applications such as running language learning apps, accessing media, and recording speech. The top citing article in this cluster is Hoi & Mu (2021), which emphasized the crucial role of teachers in guiding effective out-of-class mobile learning, covering 10 cited references.

3. SCMC

One of the most notable clusters identified in the whole period as SCMC, which focused on potential of technology to facilitate language learning through real-time digital interaction. The members of this cluster is 196, which ranges from 1959-2010, with meaning year 1999. The most cited articles was (Kern, 1995), recording 127 citations, which examined students’ language production vis synchronous written discussions. The second highly cited references was Warschauer’s (1996) article which also investigated the same issue but integrated individual student factors like proficiency, cultural background, and attitudes correlated with participation in the face to face versus SCMC. The most citing article was (Shin, 2006) which covers 18 cited articles, focusing on how ESL context could affect students; interaction in a SCMC environment.

4. Data-driven learning

The Data-Driven Learning (DDL) category in CALL research has been examined across two distinct periods, appearing as the fifth cluster in the overall timeline and as the tenth cluster in the recent period. Cluster #5, the sixth largest, comprises 71 members and is primarily concerned with guided induction in DDL. The most cited work in this cluster is by Schmidt (1990), which explores the role of consciousness in second language learning. This is followed by Johns (1991), which theorizes DDL, and Hyunsook (2008), which investigates the impact of corpus use on students’ writing improvement. The major citing article for this cluster is Smart (2014), which examines the efficacy of DDL in enhancing students’ grammatical competence. In contrast, Cluster #10, the eleventh largest cluster in the second phase, consists of 13 members and spans from 2009 to 2017. It features two key articles by Boulton (2010) and Boulton & Cobb (2017) as the most cited references, both focusing on pedagogical models of concordance use in language learning. The top citing article for this cluster is Ballance (2017), which investigates the use of different types of concordances in language learning.

5. Intercultural competence

The research area of CALL and culture, termed as “computer-assisted Languaculture learning” by Chun, has emerged as a significant trend. This is evident from its labeling as the fifth cluster, designated as #4 Intercultural Competence, which contains 107 members and spans the period from 1967 to 2017. The most highly cited work in this cluster is Lave and Wenger’s (1991) seminal book on situated learning. This is followed by Byram’s (1997) influential book on teaching and assessing intercultural competence, and Levy and Stockwell’s (2006) work emphasizing the role of culture in technology-enhanced language learning. The major citing article within this cluster is Tai (2015), which references nine other works. Notably, this cluster has seen increased activity in recent years, specifically between 2022 and 2021, with a peak in 2018 that recorded 26 cited reference works.

6. Pronunciation

The area of Computer-Assisted Pronunciation Training (CAPT) has emerged as a significant microskill research trend within the broader field of CALL. Identified as the seventh cluster by CiteSpace, this cluster comprises 47 members and spans the years from 1968 to 2006. The most highly cited works within this cluster are seminal books that have theorized the subject of pronunciation. Specifically, these include Biber’s work from 1988, Tardy and Swales’ contribution from 2014, and Halliday and Hasan’s work also from 2014. The article by Möllering in 2001 stands as the most frequently citing work within this cluster.

7. Second life

The last five years have been marked by a distinct focus on the utilization of Second Life technology in the field of CALL. This technology enables language learners to engage in immersive simulations and role-playing scenarios within a 3D virtual world, thereby offering a unique platform for practicing communication in the target language. CiteSpace identifies this as the fourth largest cluster, comprising 35 members. The most highly cited reference within this cluster is a systematic review by Lin and Lan (2015), which found that the majority of studies have focused on foreign language learners in higher education settings, particularly using open social virtual worlds like Second Life. Following this, the work by Jauregi et al. (2011) ranks as the second most cited article, exploring the use of the 3D virtual world Second Life for the development of intercultural communicative competence. Balaman and Sert’s work in 2017, emphasizing the importance of enhancing interactional competence for learners, is the third most cited article. The major citing article within this cluster is by Chen (2018), which investigates the task-based negotiation skills of EFL learners in a 3D multi-user virtual environment, specifically Second Life.

**References**

Aitchison, J. (1987). *Words in the mind : an introduction to the mental lexicon*. Blackwell.

Allwright, D. (1988). *Observation in the language classroom*. Longman.

Amiryousefi, M. (2016). The differential effects of two types of task repetition on the complexity, accuracy, and fluency in computer-mediated L2 written production: A focus on computer anxiety. *Computer Assisted Language Learning*, *29*(5), 1050-1066. <https://doi.org/10.1080/09588221.2016.1170040>

Aryadoust, V. (2020). A review of comprehension subskills: A Scientometrics perspective. *System*, *88*, 102180. [https://doi.org/https://doi.org/10.1016/j.system.2019.102180](https://doi.org/https%3A//doi.org/10.1016/j.system.2019.102180)

Aryadoust, V., & Ang, B. H. (2021). Exploring the frontiers of eye tracking research in language studies: a novel co-citation scientometric review. *Computer Assisted Language Learning*, *34*(7), 898-933.

Aydin, Z., & Yildiz, S. (2014). Using wikis to promote collaborative efl writing. *Language Learning & Technology*, *18*(1), 160-180.

Bahari, A., & Salimi, M. (2021). Challenges and affordances of developing receptive and productive skills via technology-based instruction. *CALL-EJ*, *22*(1), 25-55.

Balaman, U., & Sert, O. (2017). Development of L2 interactional resources for online collaborative task accomplishment. *Computer Assisted Language Learning*, *30*(7), 601-630. <https://doi.org/10.1080/09588221.2017.1334667>

Ballance, O. J. (2017). Pedagogical models of concordance use: correlations between concordance user preferences. *Computer Assisted Language Learning*, *30*(3-4), 259-283. <https://doi.org/10.1080/09588221.2017.1307228>

Benson, P. (2015). Commenting to learn: Evidence of language and intercultural learning in comments on youtube videos. *Language Learning & Technology*, *19*(3), 88-105.

Bergmann, J., & Sams, A. (2012). *Flip your classroom : reach every student in every class every day*. International Society for Technology in Education.

Berns, A., Gonzalez-Pardo, A., & Camacho, D. (2013). Game-like language learning in 3-D virtual environments. *Computers & Education*, *60*(1), 210-220. <https://doi.org/10.1016/j.compedu.2012.07.001>

Biber, D. (1988). *Variation across speech and writing*. Cambridge University Press. Table of contents <http://www.loc.gov/catdir/toc/cam023/87038213.html>

Blake, R. (2016). Technology and the four skills. *Language Learning & Technology*, *20*(2), 129-142.

Boulton, A. (2010). Data-driven learning: Taking the computer out of the equation. *Language Learning*, *60*(3), 534-572. <https://doi.org/10.1111/j.1467-9922.2010.00566.x>

Boulton, A., & Cobb, T. (2017). Corpus use in language learning: A meta-analysis. *Language Learning*, *67*(2), 348-393. <https://doi.org/10.1111/lang.12224>

Brandes, U. (2001). A faster algorithm for betweenness centrality. *The Journal of Mathematical Sociology*, *25*(2), 163-177. <https://doi.org/10.1080/0022250X.2001.9990249>

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77-101. <https://doi.org/10.1191/1478088706qp063oa>

Brudermann, C., Grosbois, M., & Sarré, C. (2021). Accuracy development in L2 writing: Exploring the potential of computer-assisted unfocused indirect corrective feedback in an online EFL course. *ReCALL*. <https://doi.org/10.1017/S095834402100015X>

Burston, J. (2014). MALL: The pedagogical challenges. *Computer Assisted Language Learning*, *27*(4), 344-357.

Burston, J. (2015). Twenty years of MALL project implementation: A meta-analysis of learning outcomes. *ReCALL*, *27*(1), 4-20.

Byram, M. (1997). *Teaching and assessing intercultural communicative competence*. Multilingual Matters.

Carter, R., & McCarthy, M. (1988). *Vocabulary and language teaching*. Longman.

Chapelle, C. (1990). The discourse of computer-assisted language learning: Toward a context for descriptive research. *TESOL Quarterly*, *24*(2), 199-225. <https://doi.org/10.2307/3586899>

Chen-Hsieh, J. S., Wu, W. C. V., & Marek, M. W. (2017). Using the flipped classroom to enhance EFL learning. *Computer Assisted Language Learning*, *30*(1-2), 1-21. <https://doi.org/10.1080/09588221.2015.1111910>

Chen, C.-M., & Hsu, S.-H. (2008). Personalized intelligent mobile learning system for supporting effective english learning. *Educational Technology & Society*, *11*, 153-180.

Chen, C. (2006). CiteSpace II: Detecting and visualizing emerging trends and transient patterns in scientific literature. *Journal of the American Society for information Science and Technology*, *57*(3), 359-377.

Chen, C. (2017). Science mapping: A systematic review of the literature. *Journal of Data and Information Science*, *2*(2), 1-40. [https://doi.org/doi:10.1515/jdis-2017-0006](https://doi.org/doi%3A10.1515/jdis-2017-0006)

Chen, C., Hu, Z., Liu, S., & Tseng, H. (2012). Emerging trends in regenerative medicine: a scientometric analysis in CiteSpace. *Expert Opin Biol Ther*, *12*(5), 593-608. <https://doi.org/10.1517/14712598.2012.674507>

Chen, H. J. H., Hsu, H. L., Chen, Z. H., & Todd, A. G. (2021). Investigating the Impact of Integrating Vocabulary Exercises Into an Adventure Video Game on Second Vocabulary Learning. *Journal of Educational Computing Research*, *59*(2), 318-341. <https://doi.org/10.1177/0735633120963750>

Chen, J. C. (2018). The interplay of tasks, strategies and negotiations in Second Life. *Computer Assisted Language Learning*, *31*(8), 960-986. <https://doi.org/10.1080/09588221.2018.1466810>

Chen, X., Zou, D., Xie, H. R., & Su, F. (2021). Twenty-five years of computer-assisted language learning: a topic modeling analysis. *Language learning & technology 25*(3), 151-185. [https://doi.org/http://hdl.handle.net/10125/73454](https://doi.org/http%3A//hdl.handle.net/10125/73454)

Chun, D. M. (1994). Using computer networking to facilitate the acquisition of interactive competence. *System*, *22*(1), 17-31. [https://doi.org/https://doi.org/10.1016/0346-251X(94)90037-X](https://doi.org/https%3A//doi.org/10.1016/0346-251X%2894%2990037-X)

Crosthwaite, P., Ningrum, S., & Lee, I. (2022). Research trends in L2 written corrective feedback: A bibliometric analysis of three decades of Scopus-indexed research on L2 WCF. *Journal of Second Language Writing*, *58*, 100934.

Cui, Y., & Bull, S. (2005). Context and learner modelling for the mobile foreign language learner. *System*, *33*(2), 353-367. [https://doi.org/https://doi.org/10.1016/j.system.2004.12.008](https://doi.org/https%3A//doi.org/10.1016/j.system.2004.12.008)

Ellis, R. (2003). *Task-based language learning and teaching*. Oxford university press.

Elola, I., & Oskoz, A. (2017). Writing with 21st century social tools in the L2 classroom: New literacies, genres, and writing practices. *Journal of Second Language Writing*, *36*, 52-60. <https://doi.org/10.1016/j.jslw.2017.04.002>

Eskenazi, M. (2013). Using a Computer in foreign language pronunciation training: What advantages? *CALICO Journal*, *16*(3), 447-469. <https://doi.org/10.1558/cj.v16i3.447-469>

Fathi, J., & Rahimi, M. (2022). Examining the impact of flipped classroom on writing complexity, accuracy, and fluency: a case of EFL students. *Computer Assisted Language Learning*, *35*(7), 1668-1706. <https://doi.org/10.1080/09588221.2020.1825097>

Fischer, R. (2007). How do we Know what Students are Actually Doing? Monitoring Students' Behavior in CALL. *Computer Assisted Language Learning*, *20*(5), 409-442. <https://doi.org/10.1080/09588220701746013>

Godwin-Jones, R. (2019). Riding the digital wilds: Learner autonomy and informal language learning. *Language Learning & Technology*, *23*(1), 8-25. <https://doi.org/10.125/44667>

Golonka, E., Bowles, A., Frank, V., Richardson, D., & Freynik, S. (2014). Technologies for foreign language learning: A review of technology types and their effectiveness. *Computer Assisted Language Learning*, *27*, 70-105. <https://doi.org/10.1080/09588221.2012.700315>

Halliday, M. A. K., & Hasan, R. (1976). *Cohesion in English*. Longman.

Heift, T., & Nicholson, D. (2001). Web delivery of adaptive and interactive language tutoring. *International Journal of artificial Intelligence in Education*, *12*. <https://doi.org/10.1007/s40593-015-0061-0>

Hsu, H. T. (2018). Incidental professional vocabulary acquisition of EFL business learners: Effect of captioned video with glosses. *JALT CALL Journal*, *14*(2), 119-142.

Hung, H.-T. (2015). Flipping the classroom for English language learners to foster active learning. *Computer Assisted Language Learning*, *28*(1), 81-96. <https://doi.org/10.1080/09588221.2014.967701>

Hyunsook, Y. (2008). More than a linguistic reference: The influence of corpus technology on L2 academic writing. *Language Learning and Technology*, *12*.

Jauregi, K., Canto, S., de Graaff, R., Koenraad, T., & Moonen, M. (2011). Verbal interaction in Second Life: Towards a pedagogic framework for task design. *Computer Assisted Language Learning*, *24*(1), 77-101. <https://doi.org/10.1080/09588221.2010.538699>

Johns, T. F. (1991). Should You Be Persuaded: Two Examples of Data-Driven Learning Materials. *English Language Research Journal*, *4*, 1-16.

Kenning, M. M., & Kenning, M. J. (1990). *Computers and language learning : current theory and practice*. E. Horwood.

Kern, R. (2014). Technology as pharmakon: The promise and perils of the internet for foreign language education. *The Modern Language Journal*, *98*(1), 340-357. <https://doi.org/10.1111/j.1540-4781.2014.12065.x>

Kern, R. G. (1995). Restructuring classroom interaction with networked computers: Effects on quantity and characteristics of language production. *The Modern Language Journal*, *79*(4), 457-476. [https://doi.org/https://doi.org/10.1111/j.1540-4781.1995.tb05445.x](https://doi.org/https%3A//doi.org/10.1111/j.1540-4781.1995.tb05445.x)

Kessler, G., Bikowski, D., & Boggs, J. (2012). Collaborative writing among second language learners in academic web-based projects. *Language Learning & Technology*, *16*(1), 91-109.

Krashen, S. D. (1982). *Principles and practice in second language acquisition* (1st ed.). Pergamon.

Krashen, S. D. (1985). *The input hypothesis : issues and implications*. Longman.

Lai, C., & Mingyue, G. (2011). Self-regulated out-of-class language learning with technology. *Computer Assisted Language Learning*, *24*, 317-335. <https://doi.org/10.1080/09588221.2011.568417>

Lave, J., & Wenger, E. (1991). *Situated Learning: Legitimate Peripheral Participation*. Cambridge University Press. <https://doi.org/DOI>: 10.1017/CBO9780511815355

Lee, J. S. (2019a). EFL students’ views of willingness to communicate in the extramural digital context. *Computer Assisted Language Learning*, *32*(7), 692-712. <https://doi.org/10.1080/09588221.2018.1535509>

Lee, J. S. (2019b). Quantity and diversity of informal digital learning of English. *Language Learning and Technology*, *23*(1), 114-126. <https://doi.org/10.125/44675>

Lee, L. (2011). Blogging: Promoting learner autonomy and intercultural competence through study abroad. *Language Learning & Technology*, *15*(3), 87-109.

Lee, L. (2016). Autonomous learning through task-based instruction in fully online language courses. *Language Learning & Technology*, *20*(2), 81-97.

Lee, L. (2017). Learners' perceptions of the effectiveness of blogging for L2 writing in fully online language courses. *International Journal of Computer-Assisted Language Learning and Teaching*, *7*(1), 19-33. <https://doi.org/10.4018/IJCALLT.2017010102>

Levy, M. (1997). *Computer-assisted language learning: Context and conceptualization*. Oxford University Press.

Levy, M., & Stockwell, G. (2006). *CALL dimensions: options and issues in computer assisted language learning*. L. Erbaum Associates.

Li, M. (2018). Computer-mediated collaborative writing in L2 contexts: An analysis of empirical research. *Computer Assisted Language Learning*, *31*(8), 882-904. <https://doi.org/10.1080/09588221.2018.1465981>

Lim, M. H., & Aryadoust, V. (2021). A scientometric review of research trends in computer-assisted language learning (1977 – 2020). *Computer Assisted Language Learning*. <https://doi.org/10.1080/09588221.2021.1892768>

Lin, B., & Hsieh, C.-t. (2001). Web-based teaching and learner control: a research review. *Computers & Education*, *37*(3), 377-386. [https://doi.org/https://doi.org/10.1016/S0360-1315(01)00060-4](https://doi.org/https%3A//doi.org/10.1016/S0360-1315%2801%2900060-4)

Lin, C. H., Warschauer, M., & Blake, R. (2016). Language learning through social networks: Perceptions and reality. *Language Learning and Technology*, *20*(1), 124-147.

Lin, T. J., & Lan, Y. J. (2015). Language learning in virtual reality environments: Past, present, and future. *Educational Technology and Society*, *18*(4), 486-497.

Liu, T. Y., & Chu, Y. L. (2010). Using ubiquitous games in an English listening and speaking course: Impact on learning outcomes and motivation. *Computers and Education*, *55*(2), 630-643. <https://doi.org/10.1016/j.compedu.2010.02.023>

Long, M. H. (1996). The Role of the Linguistic Environment in Second Language Acquisition. In W. C. Ritchie & T. K. Bhatia (Eds.), *Handbook of Second Language Acquisition* (pp. 413-468). Cambridge, MA: Academic Press.

Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis : a methods sourcebook* (Third edition. ed.). SAGE Publications, Inc.

Möllering, M. (2001). Teaching German modal particles: A corpus-based approach. *Language Learning & Technology*, *5*, 130-151.

Nation, I. S. P. (2001). *Learning vocabulary in another language*. Cambridge University Press. <https://doi.org/DOI>: 10.1017/CBO9781139524759

Newman, M. E. J. (2006). Modularity and community structure in networks. *Proceedings of the National Academy of Sciences*, *103*(23), 8577-8582. [https://doi.org/doi:10.1073/pnas.0601602103](https://doi.org/doi%3A10.1073/pnas.0601602103)

Oxford, R. L. (1990). *Language learning strategies*. Newbury House Publisher.

Plonsky, L., & Oswald, F. L. (2014). How Big Is "Big"? Interpreting Effect Sizes in L2 Research. *Language Learning*, *64*(4), 878-912. <https://doi.org/10.1111/lang.12079>

Rahimi, M., & Fathi, J. (2021). Exploring the impact of wiki-mediated collaborative writing on EFL students’ writing performance, writing self-regulation, and writing self-efficacy: a mixed methods study. *Computer Assisted Language Learning*, 1-48. <https://doi.org/10.1080/09588221.2021.1888753>

Reinders, H., & Wattana, S. (2014). Can i say something? The effects of digital game play on willingness to communicate. *Language Learning and Technology*, *18*(2), 101-123.

Reinders, H., & Wattana, S. (2015). Affect and willingness to communicate in digital game-based learning. *ReCALL*, *27*(1), 38-57. <https://doi.org/10.1017/S0958344014000226>

Reppen, R. (2010). *Using corpora in the language classroom*. Cambridge University Press.

Rousseeuw, P. J. (1987). Silhouettes: A graphical aid to the interpretation and validation of cluster analysis. *Journal of Computational and Applied Mathematics*, *20*, 53-65. [https://doi.org/https://doi.org/10.1016/0377-0427(87)90125-7](https://doi.org/https%3A//doi.org/10.1016/0377-0427%2887%2990125-7)

Schenker, T. (2012). Intercultural competence and cultural learning through telecollaboration. *CALICO Journal*, *29*(3), 449-470. <https://doi.org/10.11139/cj.29.3.449-470>

Schmidt, R. W. (1990). The role of consciousness in second language learning. *Applied linguistics*, *11*(2), 129-158.

Shadiev, R., Hwang, W. Y., & Huang, Y. M. (2017). Review of research on mobile language learning in authentic environments. *Computer Assisted Language Learning*, *30*(3-4), 284-303.

Shin, D.-S. (2006). ESL students' computer-mediated communication practices: Context configuration. *Language Learning & Technology*, *10*(3), 65–84. [https://doi.org/http://dx.doi.org/10125/44075](https://doi.org/http%3A//dx.doi.org/10125/44075)

Smart, J. (2014). The role of guided induction in paper-based data-driven learning. *ReCALL*, *26*(2), 184-201. <https://doi.org/10.1017/S0958344014000081>

Smith, G. G., Li, M., Drobisz, J., Park, H. R., Kim, D., & Smith, S. D. (2013). Play games or study? Computer games in eBooks to learn English vocabulary. *Computers and Education*, *69*, 274-286. <https://doi.org/10.1016/j.compedu.2013.07.015>

Solmi, M., Chen, C., Daure, C., Buot, A., Ljuslin, M., Verroust, V., Mallet, L., Khazaal, Y., Rothen, S., & Thorens, G. (2022). A century of research on psychedelics: A scientometric analysis on trends and knowledge maps of hallucinogens, entactogens, entheogens and dissociative drugs. *European Neuropsychopharmacology*, *64*, 44-60.

Stevenson, M., & Phakiti, A. (2014). The effects of computer-generated feedback on the quality of writing. *Assessing Writing*, *19*, 51-65. <https://doi.org/10.1016/j.asw.2013.11.007>

Stockwell, G. (2010). Using mobile phones for vocabulary activities: Examining the effect of the platform. *Language Learning & Technology*, *14*(2), 95-110.

Storch, N. (2013). *Collaborative writing in L2 classrooms*. Multilingual Matters.

Sundqvist, P. (2019). Commercial-off-the-shelf games in the digital wild and L2 learner vocabulary. *Language Learning & Technology*, *23*(1), 87-113. <https://doi.org/10.125/44674>

Sundqvist, P., & Wikström, P. (2015). Out-of-school digital gameplay and in-school L2 English vocabulary outcomes. *System*, *51*, 65-76. <https://doi.org/10.1016/j.system.2015.04.001>

Swales, J. M. (1990). *Genre analysis : English in academic and research settings*. Cambridge University Press. Publisher description <http://www.loc.gov/catdir/description/cam024/90002464.html>

Tai, S.-J. D. (2015). From TPACK-in-action workshops to classrooms: CALL competency developed and integrated. *Language, Learning & Technology*, *19*, 139-164.

Thornton, P., & Houser, C. (2005). Using mobile phones in English education in Japan. *Journal of Computer Assisted Learning*, *21*(3), 217-228. [https://doi.org/https://doi.org/10.1111/j.1365-2729.2005.00129.x](https://doi.org/https%3A//doi.org/10.1111/j.1365-2729.2005.00129.x)

Tsai, C.-H., Cheng, C.-H., Yeh, D.-Y., & Lin, S.-Y. (2017). Can learning motivation predict learning achievement? A case study of a mobile game-based English learning approach. *Education and Information Technologies*, *22*(5), 2159-2173. <https://doi.org/10.1007/s10639-016-9542-5>

Van Eck, N., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *scientometrics*, *84*(2), 523-538.

Vurdien, R. (2013). Enhancing writing skills through blogging in an advanced English as a Foreign Language class in Spain. *Computer Assisted Language Learning*, *26*(2), 126-143. <https://doi.org/10.1080/09588221.2011.639784>

Vurdien, R. (2017). Mobile assisted vocabulary acquisition and wikis to enhance writing skills. *International Journal of Computer-Assisted Language Learning and Teaching (IJCALLT)*, *7*(2), 1-21. <https://doi.org/10.4018/IJCALLT.2017040101>

Vygotsky, L. S., & Cole, M. (1978). *Mind in society: the development of higher psychological processes*. Harvard University Press.

Wang, S., & Smith, S. (2013). Reading and grammar learning through mobile phones. *Language Learning & Technology*, *17*(3), 117-134.

Wang, S., & Vasquez, C. (2012). Web 2.0 and Second language learning: What does the research tell us? *CALICO Journal*, *29*, 412-430. <https://doi.org/10.11139/cj.29.3.412-430>

Warschauer, M. (1996). Comparing face-to-face and electronic discussion in the second language classroom. *CALICO Journal*, *13*(2/3), 7-26. <http://www.jstor.org/stable/24147896>

Warschauer, M. (1997). Computer-mediated collaborative learning: Theory and practice. *The Modern Language Journal*, *81*(4), 470-481. [https://doi.org/https://doi.org/10.1111/j.1540-4781.1997.tb05514.x](https://doi.org/https%3A//doi.org/10.1111/j.1540-4781.1997.tb05514.x)

Wilson, J., & Czik, A. (2016). Automated essay evaluation software in English Language Arts classrooms: Effects on teacher feedback, student motivation, and writing quality. *Computers and Education*, *100*, 94-109. <https://doi.org/10.1016/j.compedu.2016.05.004>

Winke, P., Gass, S., & Sydorenko, T. (2013). Factors influencing the use of captions by foreign language learners: An eye-tracking study. *Modern Language Journal*, *97*(1), 254-275. <https://doi.org/10.1111/j.1540-4781.2013.01432.x>

Yilmaz, Y., & Granena, G. (2010). The effects of task type in Synchronous Computer-Mediated Communication. *ReCALL*, *22*(1), 20-38. <https://doi.org/10.1017/S0958344009990176>

Ziegler, N. (2016). Taking technology to task: Technology-mediated TBLT, performance, and production. *Annual Review of Applied Linguistics*, 36, 136-163.

1. We mean by labelling the term “Hotspot areas of research” to an area of CALL that is thoroughly investigated in the CALL literature that could be identified through research clusters outputted by CiteSpace. [↑](#endnote-ref-2)