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A systematic review of collaborative mobile-assisted language learning (C-MALL) practices using bibliometric, content, and scientometric analyses

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The rapid proliferation of mobile technology and its widespread integration in education, particularly in language instruction and acquisition, as well as its effectiveness in facilitating collaborative learning, have recently sparked a surge in research focused on collaborative mobile-assisted language learning (C-MALL). This review sought to delineate the current landscape of literature on C-MALL practices, pinpoint research trends, and propose avenues for future research while providing valuable insights for C-MALL pedagogical strategies. To achieve this objective, the review adhered to the PRISMA protocol, analyzing 72 studies sourced from five databases following stringent inclusion and exclusion criteria. Key findings encompassed: (1) an escalating yearly publication trend on C-MALL practices, with a substantial spike observed post-2019; (2) a dominant contribution from Asian nations in terms of publication volume; (3) a prevalence of studies conducted in higher education settings employing mixed-method or quantitative methodologies on small sample sizes over short durations; (4) C-MALL designs predominantly leveraging social media collaborative learning platforms via smartphones; and (5) the most prominent keywords being motivation, writing, and engagement. The implications of these findings for both researchers and educational practitioners were thoroughly deliberated upon as per the review outcomes.

Introduction

The rapid progress in Information and Communication Technology (ICT) and the widespread use of portable, internet-connected mobile devices have disrupted conventional classroom instruction, leading to the emergence of mobile learning (m-learning). Multiple mobile devices such as smartphones, iPads, iPods, and PDAs have made their way into education due to the potential of mobile learning environments to transcend time and space constraints while providing access to a vast array of educational resources (Andujar, 2016). Within the realm of education, language learning has emerged as a particularly notable area of study to investigate the influence of m-learning (Krull and Duart, 2017). As the exploration of the impact of

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m-learning on language education has expanded, the concept of mobile-assisted language learning (MALL) has gained significant attention.

In recent years, a significant trend in Mobile-Assisted Language Learning (MALL) research has focused on mobile-assisted collaborative language learning (C-MALL) (Kukulka-Hulme and Viberg, 2018), highlighting the potential of MALL in supporting collaborative learning. Collaborative Learning (CL) is a process of constructing knowledge (Miyake and Kirschner, 2014) that involves learners working together in groups to solve problems, complete tasks, or create a product (Iglesias Rodríguez et al., 2017). The integration of information technology has enabled the creation of educational mobile applications that facilitate frequent and meaningful interactions among language learners, offering more authentic and engaging learning experiences with peers to construct knowledge (Kukulka-Hulme, 2009), both in and outside the classroom setting.

The use of mobile devices to support Collaborative Learning (CL) has been overlooked for a long time. Kukulka-Hulme and Shield (2008) pointed out that previous Mobile-Assisted Language Learning (MALL) research primarily concentrated on delivering content rather than fostering collaboration. However, there was a growing trend towards promoting learner interaction, calling for more research efforts in Collaborative Mobile-Assisted Language Learning (C-MALL). Froberg et al. (2009) observed a lack of focus on the communication and collaboration aspects of mobile devices in their review of 102 mobile learning projects, which mainly involved laptops. Similarly, Burston (2014) underscored a prevalent emphasis on individual learning over collaborative learning. Furthermore, Sung, Chang, and Yang's (2015) quantitative meta-analysis, spanning from 1993 to 2013, examining the efficacy of mobile devices in language acquisition, showed a small and statistically insignificant overall effect size for CL.

In recent years, there has been a surge in interest in C-MALL research, driven by the increasing intelligence of smartphones, making them akin to computers. Researchers are increasingly delving into the efficacy of mobile-assisted collaboration in language acquisition, showcasing its advantages across various language learning contexts. For example, it can enable collaborative writing among learners, leading to improved writing outcomes (Wang and Song, 2023; Palaoan et al., 2023). Furthermore, it fosters student-student interaction beyond the classroom, thereby enhancing their communication skills (Kartal, 2022; Baek and Lee, 2021; Tragant et al., 2022). Moreover, it has been shown to positively impact receptive skills such as reading (Xu et al., 2023), listening (Andujar and Hussein, 2019; Al-Zahrani, 2015), and vocabulary (Al-Ahdal and Alharbi, 2021).

Despite the growing body of research, there is a dearth of comprehensive reviews examining the current landscape of C-MALL literature and its evolution. Prior reviews have predominantly surveyed previous MALL studies, with a focus on the affordances of supporting collaborative learning as one of their key analytical lenses. It wasn't until 2018 that Kukulka-Hulme and Viberg (2018) conducted the first dedicated review of C-MALL studies published between 2012 and 2016, presenting a cutting-edge analysis of how mobile technologies have been leveraged to bolster collaborative language learning among L2/FL students. This review offers a detailed exploration of C-MALL implementation through the lenses of affordances, pedagogical strategies, second language acquisition principles, and affective designs, aiming to guide future practices. Notably, the review emphasizes learning design, particularly emphasizing the process and steps involved in collaborative mobile learning within their recommendations. However, it falls short of providing a comprehensive overview of C-MALL studies.

Unlike traditional narrative literature reviews, a systematic literature review (SLR) is a specific type of review that employs rigorous and explicit methods to systematically synthesize all available materials with minimal bias. It offers a robust, transparent, and exhaustive approach to consolidating research findings, providing valuable insights for advancing knowledge, guiding decision-making, and pinpointing future research avenues. Several researchers have endeavored to conduct SLRs within the realm of Mobile-Assisted Language Learning (MALL) or technology-enhanced learning. However, SLRs specifically focusing on Collaborative Mobile-Assisted Language Learning (C-MALL) are still scarce.

For example, Fu and Hwang (2018) performed an SLR that scrutinized the literature on mobile technology-supported Collaborative Learning (CL) from 2007 to 2016. Their findings revealed a growing body of research on mobile-assisted CL, notably in the social sciences, and highlighted a stronger integration of new mobile technologies with CL activities. Nevertheless, this review did not give explicit attention to language learning. Similarly, in the same context, Hwang and Fu (2018) conducted another SLR of publications between 2007 and 2016 in selected journals indexed in the Social Sciences Citation Index (SSCI), exploring the research design trends and application of MALL. They noted a significant shift towards emphasizing the development of multiple language skills in authentic learning settings instead of merely enhancing individual language skills. However, this review did not delve into how MALL leverages its affordances to facilitate CL.

Furthermore, the SLR conducted by Su and Zou (2020) focused on the theoretical underpinnings, technologies, and implications of technology-enhanced collaborative language learning, albeit without restricting the technology scope solely to mobile devices. Hence, the existing landscape underlines the crucial necessity for a systematic and all-encompassing review to scrutinize the role of mobile devices in fostering collaborative language learning and to identify emerging trends for informing future research and pedagogical approaches. Consequently, this forthcoming SLR aims to enrich the existing literature by mapping the trajectory of previous empirical studies on C-MALL and delineating its evolution.

Bibliometric and scientometric analysis methods are utilized alongside traditional content analysis to augment the comprehensiveness of this systematic literature review (SLR). This strategy aligns with the increasing practice of amalgamating systematic reviews with science mapping tools (Cobo et al., 2011). CiteSpace, created by Chen Chaomei's team at Drexel University, is an example of such a science mapping tool aimed at detecting, analyzing, and visualizing patterns and trends within a particular knowledge domain (Chen, 2004, 2006). Although less prevalent in social sciences, the authors have identified evidence from the language-learning domain (e.g., Xu and Nie, 2015; Aryadoust, 2020; Yu, 2019) showcasing the viability of using CiteSpace for conducting SLRs in pertinent fields.

Therefore, this CiteSpace-supported SLR is undertaken with two primary objectives in mind: firstly, to map the landscape of existing C-MALL empirical research from its origins to the present, encompassing its distribution and detailed implementations; secondly, to scrutinize the development trends of C-MALL research by pinpointing research hotspots and frontiers using CiteSpace. Three research questions are devised correspondingly:

RQ1: How were C-MALL empirical studies distributed in terms of year, country/region, and journal?

RQ2: How were C-MALL empirical studies implemented in terms of context, research methodology, C-MALL design, and effectiveness?

RQ3: What were the research hotspots and research frontiers of C-MALL empirical studies?

Methodology

A systematic review employs rigorous and formal methodologies to identify, select, and evaluate research studies in order to address clearly defined research questions (Mackenzie et al., 2012). This process involves several essential stages: formulating the research questions, conducting searches across various databases, scrutinizing studies based on predetermined eligibility criteria, and analyzing and combining data from the studies to respond to the research questions (Xiao and Watson, 2017). The searching and screening phases typically adhere to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, an evidence-based, structured guideline designed to assist researchers in performing and reporting high-quality systematic reviews (Page et al., 2021).

Systematic literature reviews (SLRs) usually employ one or two analysis methods: bibliometric analysis, content/thematic analysis, and scientometric analysis (e.g., Yu, 2019; Aryadoust, 2020; Okumuş Dağdeler, 2023). A few studies have incorporated all three analytical methods to offer a comprehensive insight into a particular research domain. For instance, Safura Zabidin et al. (2020) investigated the current status and research direction in the realm of Industry 4.0 construction engineering using these triple analytical methods. Similarly, Zhai and Razali (2023) examined the existing research landscape and trends concerning a genre-based approach in ESL/EFL writing pedagogy. Moreover, Wagino et al. (2023) systematically explored the integration of collaborative learning (CL) and e-learning in higher education by employing bibliometric analysis and content analysis, with support from the visualization tool VOSviewer.

Drawing from the successful methodologies employed in these studies, this research aims to combine and leverage the strengths of triple analytical methods to thoroughly analyze the current status and emerging research trends in Collaborative Mobile-Assisted Language Learning (C-MALL) practices. Each analytical method is specifically tailored to address distinct research questions. Initially, the included articles underwent bibliometric analysis to provide a comprehensive overview of the descriptive data, such as the distribution of studies by year, country/region, and journal. Subsequently, a content analysis was conducted to examine the data in categorical terms, focusing on detailed C-MALL practices from a microscopic perspective. Lastly, scientometric analysis enabled by text mining and the visualization tool CiteSpace was utilized to unveil the developmental dynamics of empirical studies in C-MALL by analyzing research hotspots, trends, and shifts over time.

PRISMA. This study adhered to the most recent PRISMA framework, updated in 2020 (Page et al., 2021), comprising three key phases: identification, screening, and inclusion. The search and filtering process is illustrated in Fig. 1.

Identification. The identification process was carried out in October 2023 across five databases: Web of Science (WoS) core collection, WoS ProQuest, SCOPUS, ERIC, and Dimensions for C-MALL studies from the beginning of the research field until the search date. A search string “(((TS = (mobile learning)) AND TS = (language)) AND TS = (collaborat*))” was utilized to retrieve articles or documents containing “mobile learning,” “language,” and words commencing with “collaborat” (e.g., collaborate, collaboration, collaborative, etc.) in their titles, abstracts, and keywords.

Initially, the search was executed in the WoS core collection, focusing on four esteemed indexes: Science Citation Index Expanded, Social Science Citation Index, Arts and Humanities Citation Index, and Emerging Sources Citation Index, yielding

204 results. Subsequently, the same search criteria were applied in WoS ProQuest Dissertation and Theses Citation Index, yielding 74 hits. Further, the identical search query in Scopus yielded 8497 outcomes, while ERIC yielded 3935 records, and Dimensions contributed 544 findings.

Screening. The screening phase is crucial in the research process, where the authors select and filter articles based on specific inclusion and exclusion criteria outlined in Table 1. The screening procedure involves three key steps. The initial screening phase focused on eliminating publication types other than peer-reviewed journal articles and dissertations, non-English works, and duplicates, resulting in 7684 records remaining.

The second screening phase involved assessing titles and abstracts, removing 7520 irrelevant articles, and leaving 164 articles for further evaluation. Despite one article that could not be located via any means, 163 articles were retrieved for the third screening step focusing on eligibility assessment. Upon thorough examination of the full articles, 91 items were ultimately excluded due to various reasons such as being non-English, duplicates, primarily related to educational technology, not pertaining to collaborative language learning, lacking empirical research, and not associated with mobile learning.

Included. A total of 72 empirical studies (including six dissertations from WoS ProQuest) focusing on the impact of mobile device-assisted collaborative language learning on language learning outcomes were ultimately selected for further analysis.

Bibliometric analysis. A bibliometric analysis entails the utilization of mathematical and statistical methodologies on a vast array of bibliographic resources within the domain of library and information science (Pritchard, 1969; Broadus, 1987; Yang et al., 2020). This approach predominantly emphasizes the quantitative assessment of academic literature, producing descriptive insights into distributional characteristics, collaborative networks, etc. (Nakagawa et al., 2019). For over a century, it has been extensively applied across various disciplines to aid researchers in identifying research gaps and avenues for further exploration (Hood and Wilson, 2001).

With the rapid advancement of multidisciplinary databases such as Web of Science (WoS) and Scopus, alongside education-specific repositories like ERIC, an increasing number of linguists and educational practitioners have demonstrated their capability and the viability of conducting bibliographic inquiries in the realm of Teaching English as a Second Language or Teaching English as a Foreign Language (TESL/TEFL) (Yang et al., 2020; Feng and Chen, 2022; Pearson, 2022). In this research, bibliometric methods were largely employed to perform a quantitative analysis of the 72 included studies in addressing the primary research question: How were the C-MALL empirical studies distributed concerning year, country/region, and journal? Notably, within this context, country/region denotes the geographical location where the C-MALL educational practices took place, distinct from the authors' affiliations, which typically align in most instances. The term “journals” pertains to the publication sources of the articles or the institutions where unpublished dissertations originate.

Content analysis. Content analysis is a systematic approach that involves analyzing written, spoken, or visual texts by applying predetermined categories to identify recurring patterns. This method ensures objectivity, replicability, and reliability (Khirfan et al., 2020). This research used content analysis to address the second research question: How were C-MALL empirical studies

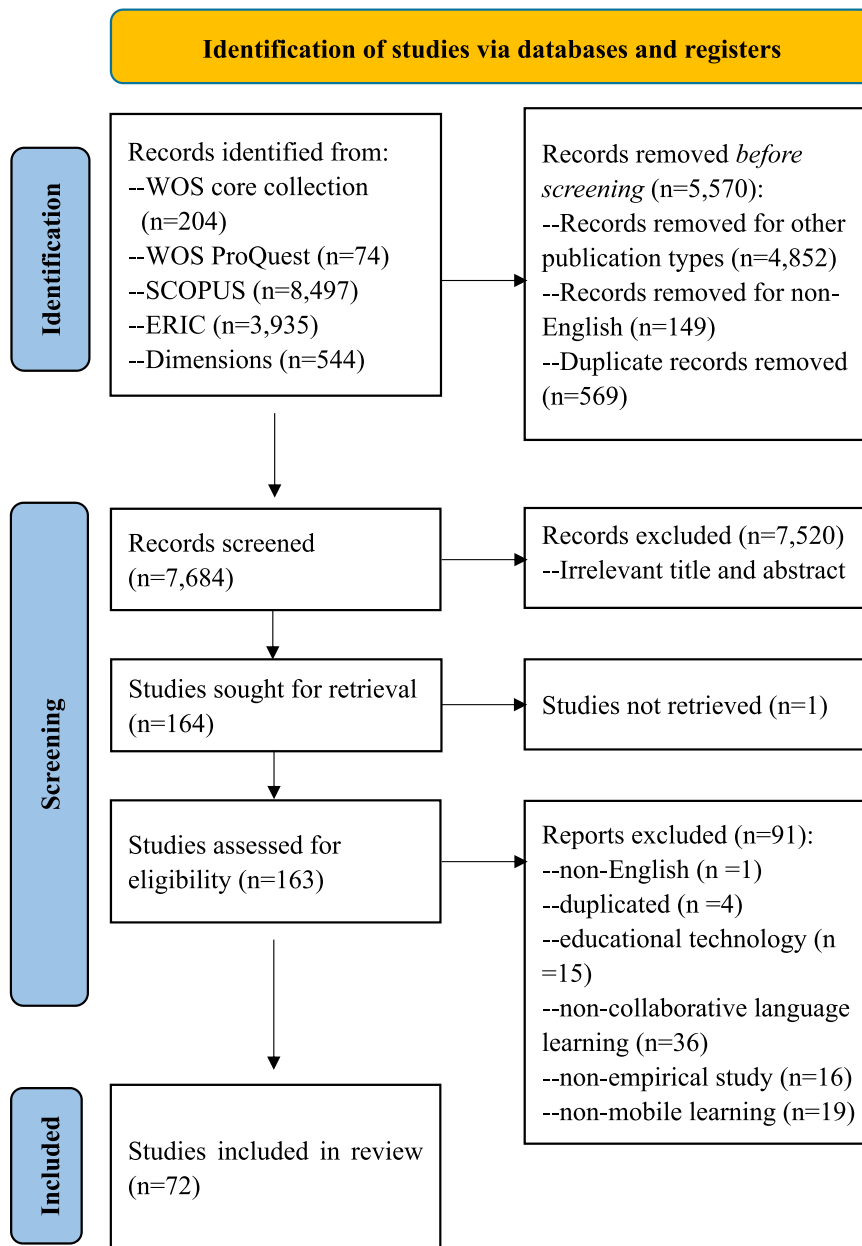


Fig. 1 PRISMA flowchart for literature search and filtration.

Table 1 Criteria for article exclusion and inclusion.

Exclusion criteria	Inclusion criteria
-non-peer-reviewed journal articles, conference proceedings, book chapters, editorials, and viewpoints	-peer-reviewed journal articles
-written in a language other than English	-dissertations
-not about collaborative language learning	-written in English
-not relevant to mobile learning	-about collaborative language learning
-not empirical studies	-relevant to mobile learning
	-empirical studies

implemented in terms of context, research methodology, C-MALL design, and effectiveness? Different coding frameworks were established for each category, including context, methodology, C-MALL design, and effectiveness, as presented in

Table 2. Subsequently, the 72 chosen articles underwent coding and analysis to explore the utilization and impact of mobile technologies in collaborative language learning settings.

Scientometric analysis with CiteSpace. Scientometric analysis represents an advancement in bibliometric methodologies, evolving towards a more comprehensive approach involving systematic mapping (Sabe et al., 2022). It goes beyond the basic descriptive data of bibliometrics by enabling the visualization and mapping of a particular research field’s developmental dynamics and evolution over time. Kumar et al. (2015) propose that science mapping and visualization tools provide a promising solution for managing vast amounts of scholarly literature. Such tools aid users in exploring the structure, trends, and changes within a field by creating visual maps based on citation data. CiteSpace, recognized as one of the leading science mapping tools (Kumar et al., 2015; Chen, 2017), offers various scientometric analysis

Table 2 Coding schemes for content analysis.

Category	Subcategories	Coding items	References
Context	Learner type	Elementary school, secondary school, higher education, teachers, working adults, others, non-specified	Fu and Hwang (2018)
Methodology	Language type	L1, L2/FL	Hwang and Fu (2018)
	Research methods	Quantitative, qualitative, mixed methods, other	Pimmer et al. (2016), Fu and Hwang (2018)
C-MALL design	Sample size	Small (<30), medium (30-50), medium to large (51-100), large (>100), non-specified	Hwang and Fu (2018)
	Duration	One session, short-term (<10 weeks), intermediate-term (11 weeks-4 months), long-term (>4 months), non-specified	Hwang and Fu (2018)
	Language skill and knowledge	Vocabulary, grammar, listening, speaking, reading, writing, translating, integrated skills, and other	Su and Zou (2020)
	Types of mobile devices	Wearable devices, smartphones, tablet computers, traditional portable computers or devices, mixed or varied, non-specified	Wu et al. (2012)
	Types of mobile technologies	Social media-based collaborative learning systems, ubiquitous mobile learning systems, course management systems, video conferencing tools, cloud-based collaborative writing systems, project-based collaborative learning systems, mixed, other, non-specified	Su and Zou (2020),
Effectiveness	Group size	Small (2-3 people), medium (4-5 people), large (>5 people), mixed size group, non-specified	Fu and Hwang (2018)
	Inferential statistics Non-inferential statistics	Positive, negative, not significant, mixed results	Fu et al. (2022)

functions, such as collaboration network analysis, co-word analysis, author/document co-citation analysis, and text/geospatial visualizations (Chen, 2017).

The scientometric approach was employed in this research to address the third research inquiry: what were the primary research hotspots and frontiers of empirical studies on Collaborative Mobile-Assisted Language Learning (C-MALL)? Data from 48 selected empirical C-MALL studies sourced from Scopus (out of the 72 articles across 5 databases) were subjected to analysis using CiteSpace software. Keyword co-occurrence analysis was specifically utilized to pinpoint research hotspots and frontiers, enabling a detailed illustration of the trend within the C-MALL domain.

Maintaining data consistency within a single database is essential to ensure uniformity in the data structure, which is vital for accurate processing and visualization within CiteSpace. Additionally, exclusively utilizing one database streamlines the process, as analyzing data from multiple sources can be intricate and time-consuming, simplifying the analysis and enhancing replicability. Furthermore, the majority of the reviewed studies originate from Scopus, a renowned database known for its stringent data curation and quality control procedures. This database offers comprehensive abstracts and citation-based metadata that are reliably and accurately indexed (Kumar et al., 2015). These attributes are highly advantageous for conducting CiteSpace analysis. Hence, solely the 48 articles sourced from Scopus were considered as the data for scientometric analysis.

Data analysis and discussion

Results of bibliometric analysis. The bibliometric analysis method was utilized to gain an in-depth understanding of the distribution patterns of the selected articles in terms of yearly publication, country/region, and journal.

Publication distribution by year. Figure 2 presents the annual distribution trend of previous C-MALL empirical studies in L2/FL teaching and learning contexts. The first papers on C-MALL empirical trials emerged in 2015, with 3 publications (Kim, 2015; Freiermuth, 2015; Al-Zahrani, 2015). Although supporting mobile collaboration in educational settings is challenging (Reychav and Wu, 2015), C-MALL studies exhibited consistent

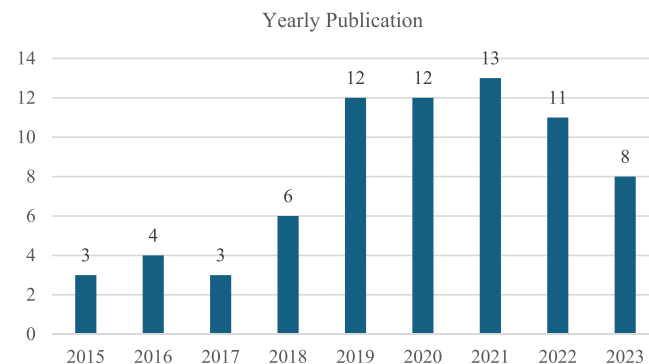


Fig. 2 Publication distribution by year.

growth from 2015 to 2018. Subsequently, a substantial upsurge in publications was observed in 2019, peaking in 2021 with 13 articles. This slightly decreased to 11 articles in 2022. However, up to the search date in October 2023, 8 articles have already been published, indicating a sustained interest in C-MALL empirical research.

The publication trend aligns with the progress of mobile technology over the past decade, characterized by a sharp rise in smartphone ownership rates, driven by the availability of affordable Android smartphones, enhanced internet connectivity, and the proliferation of mobile applications.

Publication distribution by country/region. Figure 3 illustrates the country/region distribution of the included C-MALL empirical studies and the global contribution of C-MALL researchers. The analyzed C-MALL studies were carried out in 20 countries and regions spanning Asia, Europe, America, and Australia, indicating a widespread interest in leveraging mobile devices for collaborative language learning. Particularly, Asian countries showcased significant enthusiasm for C-MALL implementation. Among the nine countries with more than three publications, five hailed from Asia, with a collective 36 articles constituting 50% of the total reviewed studies, including Taiwan (12), mainland China (10), Indonesia (6), Korea (5), and Malaysia (3). This finding aligns with Su and Zou’s (2020) assessment of

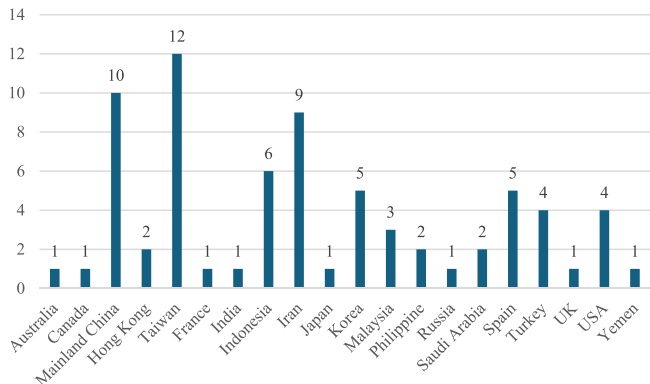


Fig. 3 Publication distribution by country/region.

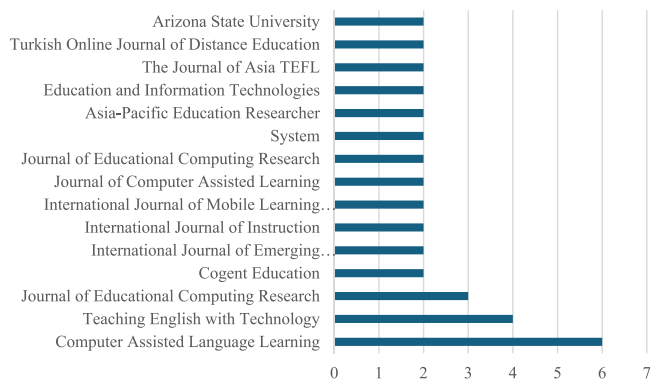


Fig. 4 Journal distribution.

technology-enhanced collaborative language learning, underscoring the zealous pursuit of technology—and mobile technology, in particular—by Asian researchers. This trend could be attributed to the substantial population of ESL/EFL learners in these regions and their keen focus on science and technology, which has manifested in notable advancements in recent years.

Middle East countries have also demonstrated interest in C-MALL research, with notable participation from Iran (9), Turkey (4), Saudi Arabia (2), and Yemen (1). In addition, significant contributions to C-MALL teaching practices have been made by some European and American developed countries like Spain (5) and the USA (4). Particularly in the realm of English language teaching and learning, it is unsurprising to observe a higher implementation of specific pedagogies in ESL/EFL contexts. It is important to note that the findings presented only pertain to the current landscape of the included studies, which were limited to C-MALL empirical practices in L2/FL teaching and learning contexts. Several prominent researchers and robust scientific communities from various regions have made substantial contributions to the field of MALL and C-MALL. However, some studies were excluded from this review based on predefined criteria. For instance, Dr. Agnes Kukulska-Hulme from the UK and Dr. Olga Viberg from Sweden have conducted numerous studies, either individually or collaboratively, in MALL and C-MALL, yet many were not included due to their non-empirical nature.

Top 15 journals with the most C-MALL publications. Academic journals are essential in exchanging, disseminating, and inheriting scientific findings. The journals in which articles are published are indicative of the quality of research output. The 72 selected articles in this research appeared across 47 different journals. Among these, 15 journals have published more than two empirical studies on C-MALL, as depicted in Fig. 4. Notably,

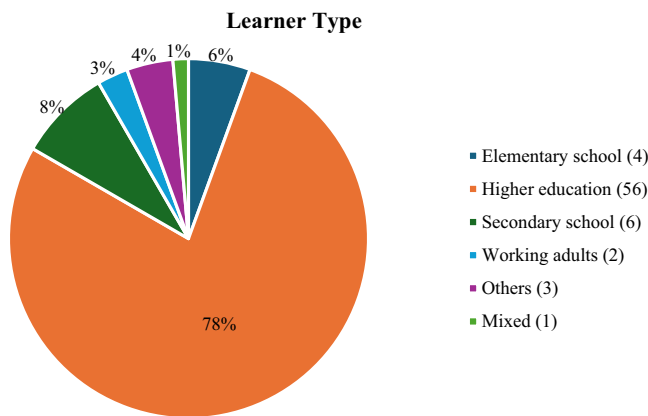


Fig. 5 Distribution of learners from different school levels.

Computer-Assisted Language Learning has published the highest number of C-MALL empirical articles to date (6), followed by Teaching English with Technology (4) and Journal of Educational Computing Research (3). The remaining 12 journals or universities each have two C-MALL articles in their publications before this review. Among the top 15 journals, six are indexed in the Social Science Citation Index (SSCI), with a total of 17 articles, while three are from the Emerging Sources Citation Index (ESCI), contributing six articles. Additionally, there were some other SSCI journals that published one empirical C-MALL study each during the review period, such as Language Education & Assessment and Computers and Education. Therefore, the authors conclude that over 30% of the selected C-MALL studies appeared in prestigious SSCI or ESCI-indexed journals, emphasizing the continuing need for high-quality empirical research in the field of C-MALL.

Results of content analysis. To figure out how C-MALL was implemented in the language teaching and learning, content analysis was employed to classify past empirical studies based on context (learner & language type), methodology, C-MALL design, and effectiveness.

Learner type. In the first context category, learner types are classified according to Fu and Hwang’s (2018) coding scheme as elementary school, secondary school, higher education, teachers, working adults, and non-specified. Figure 5 illustrates that higher education students (56, 78%) are the predominant focus of C-MALL studies, with secondary school students (6, 8%) and elementary school students (4, 6%) following in percentage distribution. This distribution aligns with the general trend observed in mobile-assisted collaborative learning studies across various disciplines (Fu and Hwang, 2018) and in mobile learning overall (Elaish et al., 2019). Notably, limited research has been carried out on working adults (2, 3%), suggesting that C-MALL studies have primarily centered on student groups within educational institutions and not extended to adult learners beyond campus settings.

Language type. The language classification system employs L1 and L2/FL as coding parameters, derived from the work of Hwang and Fu (2018). L1 denotes the primary or native language used by individuals since birth, whereas L2/FL pertains to a language acquired subsequent to L1. The authors specify the particular language in parentheses following L1 or L2/FL during coding.

Figure 6 indicates that the vast majority (66, 92%) of the reviewed studies centered on English as L2/FL learning (ESL/

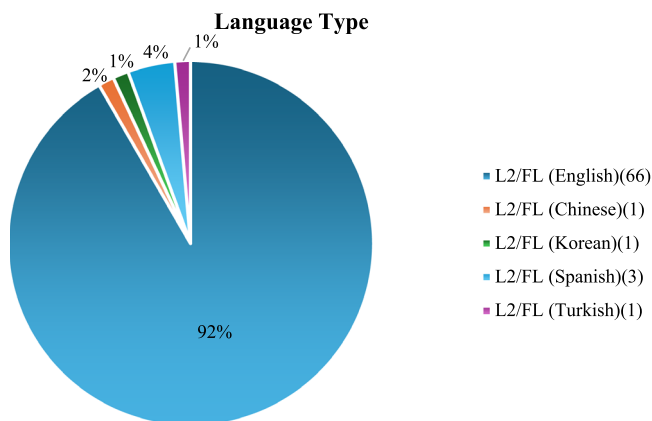


Fig. 6 Distribution of learners' language type.

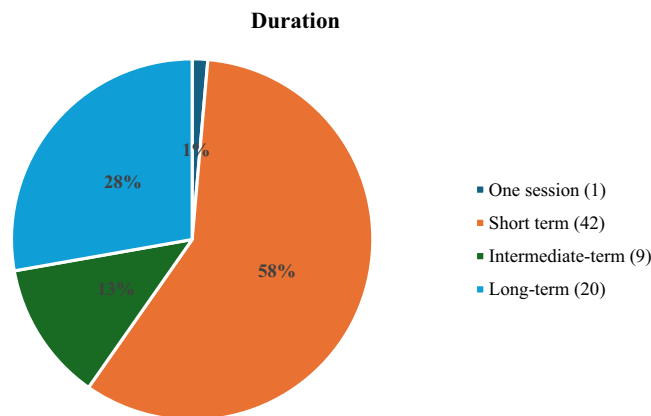


Fig. 8 Distribution of experiment duration.

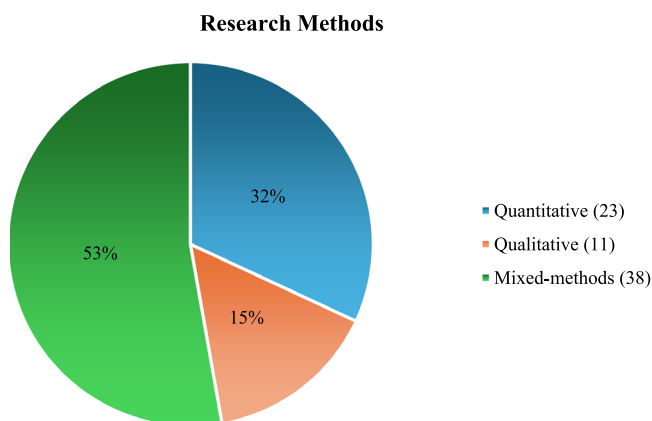


Fig. 7 Distribution of research methods.

EFL), with no examination of L1 learning, aligning with Hwang and Fu's (2018) findings on the dominance of ESL/EFL and the overlooking of native language education in MALL research. Furthermore, there were 3 (4%) studies investigating Spanish as L2/FL acquisition, whether it was Spanish as a Foreign Language (SFL) learning among German language students in Spanish higher education (Berns et al., 2016), American university students' SFL learning in their home country (Ashe, 2020), or American students' study of Spanish abroad (Domaz, 2020). Moreover, one study focused on Chinese as L2/FL learning at an Australian university (Tong et al., 2022), one on Korean as L2/FL learning at a French university (Kim, 2015), and another on Syrian undergraduate-level refugees' Turkish as L2/FL learning at a Turkish university (Tanrikulu, 2021). This illustrates the diversity in foreign language acquisition beyond the predominant English language, emphasizing the prevalence of learning L2/FL in non-target language settings.

The methodology encompasses three main subcategories: research methods, duration, and sample size.

Research methods. The research methods encompass qualitative, quantitative, and mixed methods, as categorized by Pimmer et al. (2016), augmented by an "other" category as proposed by Fu and Hwang (2018). Figure 7 illustrates that the predominant method employed in empirical C-MALL studies was mixed methods (38, 53%), followed by quantitative methodology (23, 32%). Qualitative approaches (11, 15%) were the least utilized in investigating C-MALL practices. This phenomenon is attributed to the focus on empirical studies in the C-MALL domain, predominantly utilizing experimental or action research designs in experimental

or real educational settings. Nevertheless, it is noteworthy that over half of the researchers opted to complement quantitative techniques with qualitative analyses to offer a more detailed and comprehensive insight into C-MALL practices. The qualitative studies selected mostly belonged to the case study sub-category, concentrating on describing, evaluating, and comprehending various facets of empirical practices (Al-Zahrani, 2015; Baek et al., 2017; Kayaoğlu and Çetinkaya, 2018; Jung, 2021; Tanrikulu, 2021; Tong et al., 2022).

Duration. The duration of the studies aligns with Hwang and Fu's (2018) categorization into one session, short-term (<10 weeks), intermediate-term (11 weeks-4 months), long-term (>4 months), and not specified. According to Fig. 8, the majority of the selected studies (42, 58%) implemented C-MALL practices in a short-term span of less than ten weeks. This choice may stem from the resource-intensive nature of longer-term experiments. Nonetheless, 20 studies (28%) persisted with long-term investigations exceeding four months, often spanning an academic semester, to ensure more reliable and generalizable results. Interestingly, a considerable number of long-term studies were conducted in the past five years, implying a growing inclination among researchers to immerse themselves in authentic educational settings and the fundamental principles of language acquisition, dedicating more time to evaluating the efficacy of innovative pedagogical approaches on learning outcomes. These results are in line with Hwang and Fu (2018), who noted a prevalence of short-term and long-term studies in their review of mobile language learning literature from 2007 to 2016.

Sample size. The term "sample size" denotes the minimum number of participants in both the experimental and control groups, in line with the study by Hwang and Fu (2018). Coding schemes categorized sample sizes as small (<30), medium (30-50), medium to large (51-100), large (>100), or not specified. Figure 9 illustrates that studies with fewer than 30 participants in the small size category ranked highest (35, 49%), followed by those with medium-sized groups ranging from 30 to 50 participants (21, 29%). However, 45 of the 56 small or medium-sized studies had 15-50 participants, corresponding to typical class sizes, indicating that most studies were conducted in natural educational settings with experimental designs. Furthermore, there were 11 studies with medium to large participant sizes. Notably, four out of the five large-sized studies were survey research, which usually necessitates a substantial number of participants.

The C-MALL design category comprises four subcategories: language skills and knowledge, types of mobile devices, types of technologies, and group size.

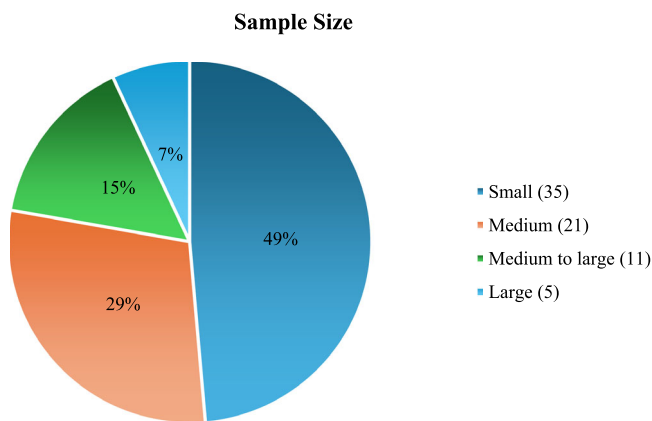


Fig. 9 Distribution of sample size.

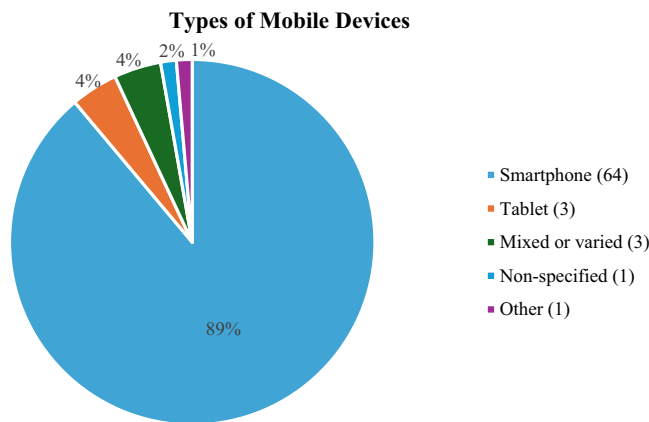


Fig. 11 Distribution of types of mobile devices.

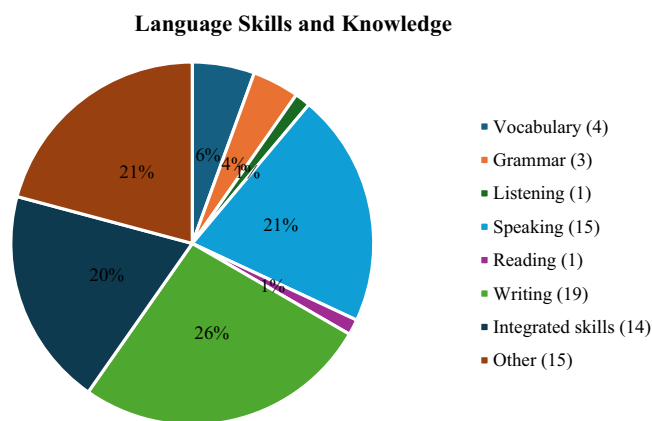


Fig. 10 Distribution of language skills and knowledge investigated.

Language skills and knowledge. The coding categories for language skills and knowledge items were adopted from Su and Zou (2020), focusing on specific language skills such as speaking, listening, reading, writing, translating, grammar, vocabulary, and integrated skills.

As depicted in Fig. 10, writing (19, 26%) emerged as the most popular language skill among C-MALL researchers, followed by speaking (15, 21%). Effective collaboration necessitates strong verbal and written communicative skills, thus making speaking and writing the most suitable skills to encourage communication and collaborative activities compared to other language skills. Only four (6%) studies concentrated on vocabulary learning, a notable difference from Elaiish et al. 's (2019) review of mobile English language learning studies from 2010–2015, where vocabulary was the most researched skill during that period. This discrepancy may be attributed to the limited infrastructure for supporting mobile online collaboration during that period, which primarily focused on content delivery in the MALL domain.

Notably, listening and reading were the least explored language skills individually. However, they are frequently studied in conjunction with other skills, such as listening and reading in Lin et al. (2020), listening and speaking in Al-Zahrani (2015), listening and vocabulary in Saeedakhtar et al. (2021), reading and writing in Ahmed (2019), and writing and speaking in Muthmainnah et al. (2022). Furthermore, integrated skills (14, 20%) have gained traction as a focal point in C-MALL empirical investigations. Beyond fundamental language skills, other areas of interest include cognitive abilities in Hwang et al. (2018), engagement and interaction in Wrigglesworth (2019),

Imamyartha et al. (2021), Tong et al. (2022), and Tragant et al. (2022), intercultural abilities in Baek et al. (2017) and Ashe (2020), interpersonal communication skills in Freiermuth (2015), learning motivation in Imamyartha et al. (2022) and Jung (2021), productive and language use abilities (Wu, 2018, Domaz, 2020), idiomatic competence (Li and Liontas, 2023; Li, 2019), and pragmatic competence (García-Gómez, 2022).

Types of mobile devices. The categories of mobile devices encompass wearable devices, smartphones, tablet computers, traditional portable computers or devices, mixed or varied, unspecified, and others, as noted in Wu et al. (2012). According to Fig. 11, 89% (64) of the analyzed studies exclusively employed smartphones for facilitating students' mobile learning, with tablets comprising 3 (4%) studies. Three studies combined smartphones with tablets (Hosseinpour et al., 2019; Yeh and Chen, 2019) or with equipment in laboratories (Muthmainnah et al., 2022). Furthermore, one study utilized a video-making machine and unspecified editing software to aid students in their video-making projects (Jung, 2021). The results indicate that increasingly sophisticated and computer-like smartphones have emerged as the primary devices supporting students' mobile collaborative learning.

Types of technologies. The technology categories' coding items have been derived from Su and Zou (2020), focusing on mobile technologies used to enhance language learning. These categories include social media-based collaborative learning systems, ubiquitous mobile learning systems, course management systems, video conferencing tools, cloud-based collaborative writing systems, project-based collaborative learning systems, other technologies, and unspecified technologies.

According to Fig. 12, social media-based collaborative learning systems (43, 60%) were the most commonly utilized technologies for facilitating mobile collaborative learning among students. Communication apps like WhatsApp, WeChat, Telegram, LINE, Kakao Talk, Viber, and Facebook were predominantly employed. WhatsApp (20) emerged as the most used communication app, closely followed by the Chinese platform WeChat (7) and Telegram (7). Additionally, Kakao Talk (4) is a popular social media app frequently utilized in the South Korean educational context.

Project-based collaborative learning systems represented the second most frequently utilized technologies in the C-MALL practices, which include activities such as vlog or video making as discussed by Huang (2021), Chen (2021), Jung (2021), and Muthmainnah et al. (2022). Furthermore, digital storytelling was highlighted in the works of Nair and Md Yunus (2022), while

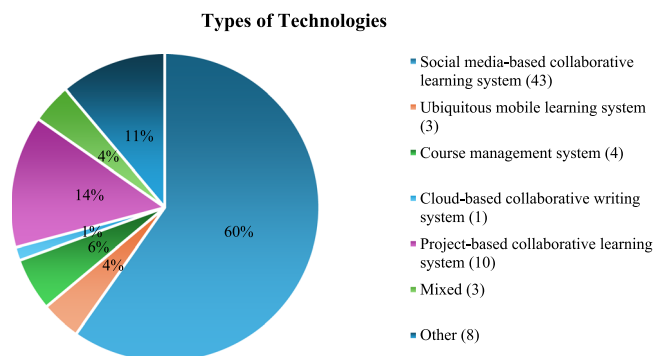


Fig. 12 Distribution of types of technologies used.

role-playing or drama production was discussed in the studies by Ebadi and Azizimajd (2023), Manabe et al. (2021), and Zhang et al. (2018). Additionally, gamified learning approaches were implemented, such as blockade-running in Liu (2022) and treasure-hunting in Freiermuth (2015).

Four studies utilized learning management systems deployed on smartphones or tablets. Xu et al. (2023) and Hosseinpour et al. (2019) employed Edmodo to validate its effectiveness in enhancing learners' reading performance and writing proficiency via collaborative essay writing activities facilitated by Edmodo. Wu and Miller (2020) used PeerEval to facilitate peer feedback and enhance speaking skills among English for Specific Purposes (ESP) learners. Likewise, Xu and Peng (2022) concentrated on English as a Foreign Language (EFL) learners' oral performance and peer feedback, employing MosoTeach, a popular Chinese teaching and learning management tool.

Three studies utilized ubiquitous mobile learning systems. Hwang et al. (2018) utilized ezTranslate, an app designed for English as a Foreign Language (EFL) speaking and listening, to facilitate peer-tutoring and enhance learners' cognitive abilities, dissemination of knowledge, and learning outcomes. Jiang and Liou (2022) conducted an action research study to assess the efficacy of Quizlet-supported collaborative vocabulary learning, which was found to positively impact students' ability to retain and apply a greater number of words in their writing. Lin et al. (2020) employed a context-aware ubiquitous language learning (CAULL) mobile system to support collaborative learning among students focusing on fitness-specific English, particularly enhancing listening and reading comprehension skills.

A single study by Yeh and Chen (2019) employed a cloud-based collaborative writing system, specifically Google Docs, a popular platform for collaborative learning in the context of Computer-Assisted Language Learning (CALL) (Su and Zou, 2020). The limited application of this system in mobile learning environments could be attributed to challenges such as smaller screen sizes and less user-friendly typing methods on mobile devices like phones or tablets (Godwin-Jones, 2017).

In addition to individual technology-focused studies, three studies employed a combination of various technologies to support collaborative learning. Rad (2021) integrated the course management system Edmodo with game-based mobile learning apps to improve grammar acquisition. Chang and Lu (2018) merged the social media platform LINE with a structured private knowledge tool to enhance student writing skills. Kartal (2022) utilized ubiquitous mobile language learning systems along with video conferencing tools concurrently to facilitate speaking practice.

Several studies have explored different technologies beyond those previously mentioned. For instance, Berns et al. (2016) utilized the game-based learning app Vocab Trainer A1, which

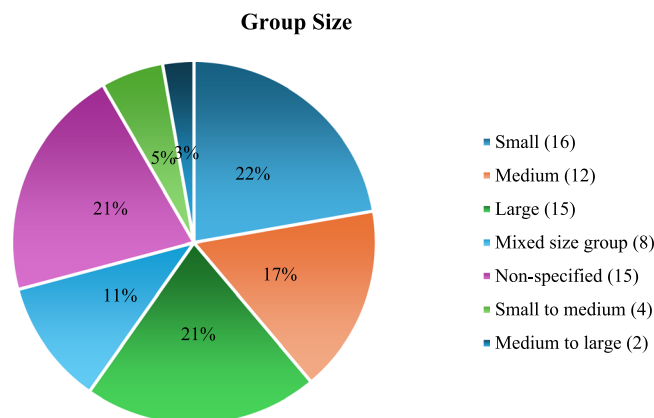


Fig. 13 Distribution of group size.

incorporated both individual and collaborative tasks, to enhance Spanish language vocabulary skills. Chang and Lin (2019) implemented the ZUVIO IRS instant response system to facilitate the recording of peer comments, improving learners' English-speaking abilities. Domaz (2020) integrated augmented reality (AR) technology to boost language usage among Spanish learners. Saeedakhtar et al. (2021) encouraged students to download podcasts from websites to smartphones, shared through the SHAREit application, to enhance listening skills and vocabulary through offline collaboration. Similarly, Al-Ahdal and Alharbi (2021) had students download learning materials on smartphones to support collaborative vocabulary learning. James and Seongrok (2023) leveraged Google Forms to strengthen students' writing skills. Moreover, Kayaoglu and Cetinkaya (2018) utilized basic short message service (SMS) on mobile phones for collaborative circular writing activities. Strikingly, Wang and Song (2023) creatively included the popular mobile multiplayer online game Honor of Kings as a warm-up activity to stimulate team spirit and engagement in collaborative prewriting discussions. These studies exemplify educators' imaginative integration of mobile technologies into language education to enhance teaching and learning practices.

Group size. The sub-category "group size" includes divisions into small (2–3 people), medium (4–5 people), large (>5 people), mixed-size groups, and non-specified groups, following Fu and Hwang's (2018) coding scheme. However, during the coding process, it was noted that some studies utilized groups with a small-to-medium number of participants (e.g., 2 to 4 in Yeh and Chen (2019) and 3 to 4 in Chang and Lu (2018)), while others adopted groups with a medium-to-large number of learners (e.g., 4 to 6 in Imamyartha et al. (2021)), as is shown in Fig. 13.

Apart from the 15 non-specified studies, those employing a small group size (2–3 people) predominated, with most structured as pair groups. Following this were studies with larger groups of more than five members, and studies utilizing medium groups of four to five people closely behind. Additionally, there were 8 studies that utilized mixed-size groups based on different tasks and students' voluntariness. These results highlight that while recommended group sizes for effective communication in electronic chat collaboration are typically four or five members (Freiermuth and Huang, 2012), actual group sizes can vary significantly based on collaborative activities and task requirements.

Effectiveness. The effectiveness category comprises two dimensions: "inferential statistics" and "non-inferential statistics", as defined by Fu et al. (2022). Each dimension consists of four

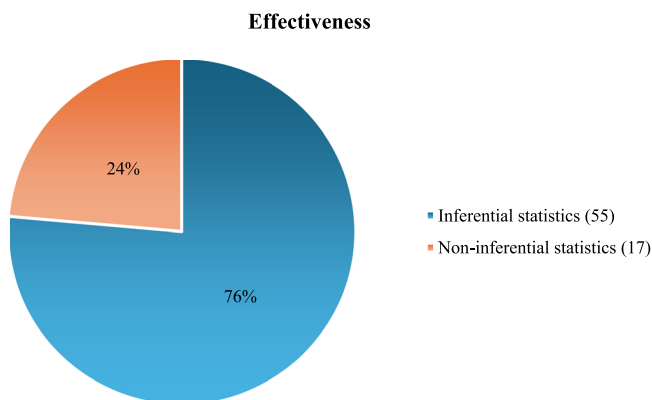


Fig. 14 Distribution of inferential statistics and non-inferential statistics results.

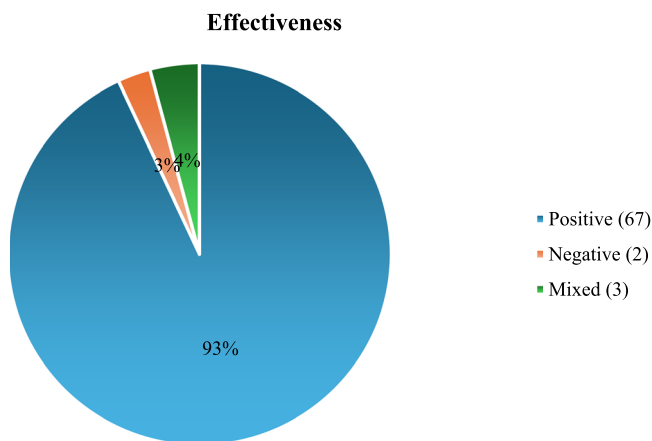


Fig. 15 Distribution of positive, negative, and mixed effectiveness.

coding items: positive, negative, not significant, and mixed results. “Inferential statistics” involve evaluating treatment effectiveness through objective statistical analyses such as T-tests, ANOVA, or Pearson Correlation. On the other hand, if effectiveness is assessed through qualitative analysis or subjective reports from participants, it falls under the non-inferential statistics sub-category.

Consistent with the prevalent research methods in C-MALL empirical studies, where mixed methods and quantitative approaches are dominant, the use of inferential statistics for statistical analysis also prevails (refer to Fig. 14). The effectiveness results, depicted in Fig. 15, show a substantial majority (67, 93%) yielding positive outcomes, with 16 falling under non-inferential statistics or being perceived as positive.

Nevertheless, two studies reported negative results, one in inferential statistics (James and Seongrok, 2023) and one in non-inferential statistics (García-Gómez, 2022). In the study by James and Seongrok (2023), nurse-patient interview activities were utilized, with students required to record their results either in a Google Form or on paper to enhance their writing skills. Contrary to expectations, the group using Google Forms performed poorly compared to the paper group in terms of overall scores, word count, and task completion rate in the post-writing test. The authors attributed this outcome to the inconvenient typing methods on smartphones in comparison to the controlled conditions of paper writing. García-Gómez (2022) designed a WhatsApp discussion group to enhance students’ interpersonal communication with native speakers. However, due to a lack of pragmatic competence, students struggled to communicate

effectively, resulting in negative perceptions regarding the usefulness of WhatsApp as a learning tool.

Results of scientometric analysis. A scientometric analysis was conducted on 48 Scopus peer-reviewed articles using CiteSpace version 6.2.R6. The goal was to visualize and map the research hotspots and frontiers, demonstrating the evolutionary trends of empirical research in C-MALL over time.

Research hotspots of C-MALL empirical studies. Due to the high-level summarization feature of keywords in a document, keyword co-occurrence analysis is considered an effective way to track research hotspots and demonstrate emerging trends within a certain research domain. Therefore, it was employed in the current review to address the third research question.

In CiteSpace, nodes symbolize the objects under analysis (referred to here as keywords), while links represent the connections between these nodes. The size of the nodes is determined by the frequency of occurrence of the keywords; a larger size indicates a higher frequency of occurrence. Similarly, the thickness of the links is directly proportional to the strength of the connection between two nodes (Li and Chen, 2017). Figure 16 illustrates the keywords co-occurrence network, comprising 133 nodes and 332 links, with a density of 0.0378, achieved by merging synonyms (e.g., mobile-assisted language learning, mobile-assisted language learning, and MALL; mobile learning and m-learning; writing skills and writing performance, etc.) and excluding keywords with broad meanings (e.g., education).

As depicted in Fig. 16, the top 10 keywords in terms of frequency were: “mobile-assisted language learning” (18), “writing” (9), “WhatsApp” (8), “mobile learning” (7), “collaborative learning” (6), “speaking” (6), “mobile instant messaging” (5), “smartphones” (4), “English as a foreign language (EFL)” (4), and “motivation” (4). Among these, keywords such as “mobile-assisted language learning,” “mobile learning,” and “collaborative learning” were indicative of C-MALL practice. “English as a foreign language (EFL)” represented the primary context for most C-MALL empirical studies. Additionally, “writing,” “speaking,” and “motivation” corresponded to the language skills or knowledge emphasized in C-MALL practice. Furthermore, “WhatsApp,” “mobile instant messaging,” and “smartphones” were the predominant mobile devices and technologies utilized to facilitate C-MALL learning and teaching.

Betweenness centrality indicates the degree to which a specific node acts as a bridge or intermediary between other nodes within a network. In CiteSpace, the red-purple ring, determined by betweenness centrality, signifies the significance of nodes (keywords in this case) within the research domain. The three keywords with the highest betweenness centrality identified in C-MALL empirical practice were “motivation” (0.54), “writing” (0.49), and “engagement” (0.47). As learners’ motivation and engagement in the language learning process constitute crucial affective factors that influence the effectiveness of C-MALL practice (Kukulka-Hulme and Viberg, 2018), they are often used by researchers to elucidate study results or as learning outcomes that could be enhanced through the application of C-MALL methods (e.g., Imamyartha et al., 2022).

Each cluster represents a closely related group of keywords centered around a particular topic or theme, reflecting diverse research directions and backgrounds within a specific field. Figure 17 displays the keywords clustering analysis generated by CiteSpace with a modularity of 0.6656 and a silhouette score of 0.8636, indicating a strong thematic coherence of keywords within clusters. The top ten clusters presented were collaborative learning (#0), peer-tutoring (#1), WhatsApp (#2), m-learning

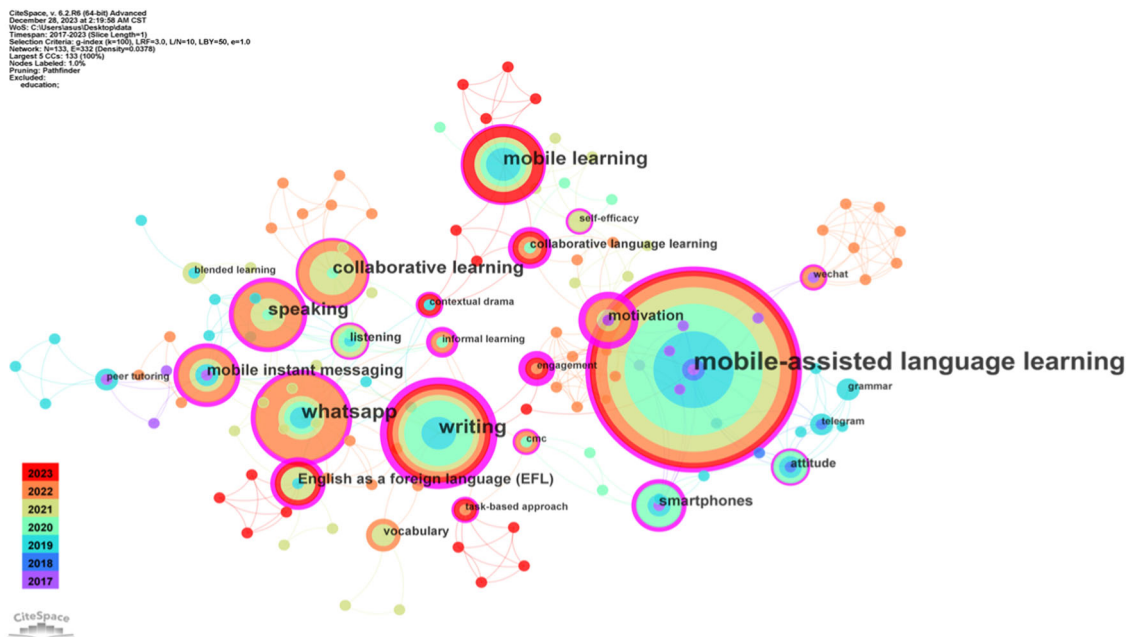


Fig. 16 Keywords co-occurrence network of C-MALL empirical studies.

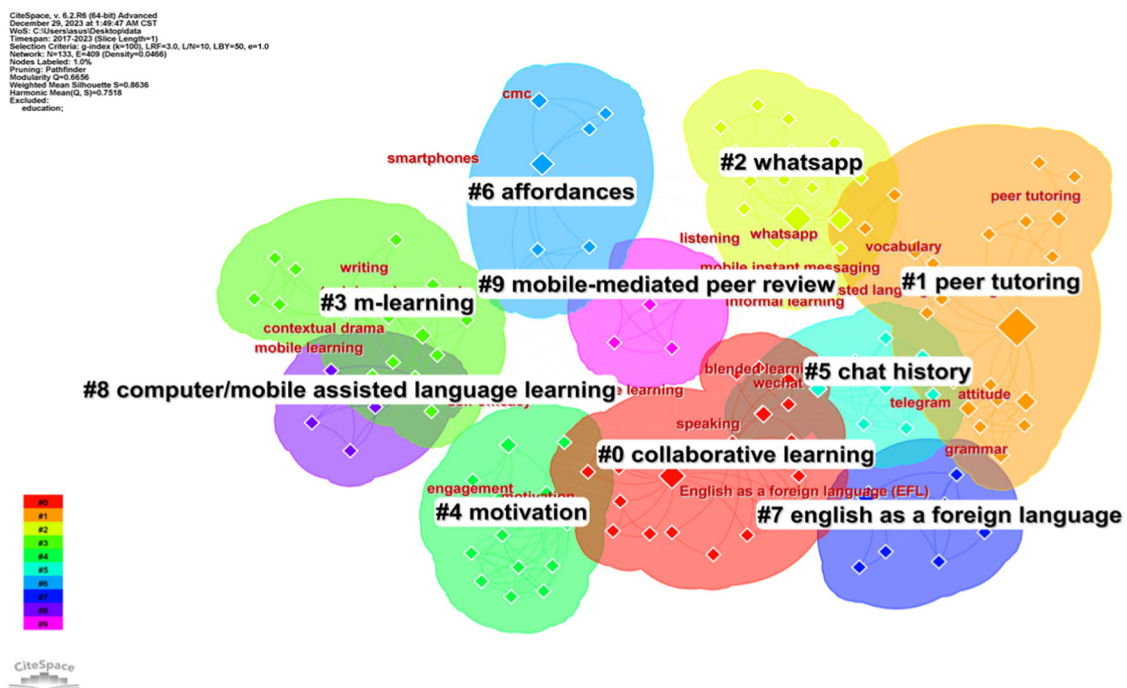


Fig. 17 Visualization of keywords clustering.

(#3), motivation (#4), chat history (#5), affordances (#6), English as a foreign language (#7), computer/mobile-assisted language learning (#8), and mobile-mediated peer review (#9). Subsequently, a timeline view (Fig. 18) was produced by CiteSpace to illustrate the evolution of clusters over time. The distribution of keywords, while relatively dispersed, primarily clustered around three distinct time periods: 2017–2018, 2019–2021, and 2022–2023.

In the years 2017–2018, the focus of reviewed studies revolved around the educational affordances of C-MALL, such as promoting collaborative language learning, enhancing motivation, and improving learning outcomes. As Kukulka-Hulme and Viberg (2018) highlighted, the increased adoption of C-MALL in

language teaching was due to its educational potential. Subsequently, from 2019 to 2021, most C-MALL initiatives centered on designing teaching methods and leveraging mobile devices to support various language learning and teaching aspects. In the latest period, from 2022 onwards, researchers began considering affective factors that may impact the effectiveness of C-MALL, such as engagement and students’ beliefs, while teaching design remained a predominant focus. Since 2017, motivation has emerged as a central research theme, investigating learners’ motivation in using smartphone technologies like WeChat, mobile English messaging, and geocaching (a treasure-hunting game in the C-MALL context). This topic has remained prominent throughout the review period, increasingly intertwined

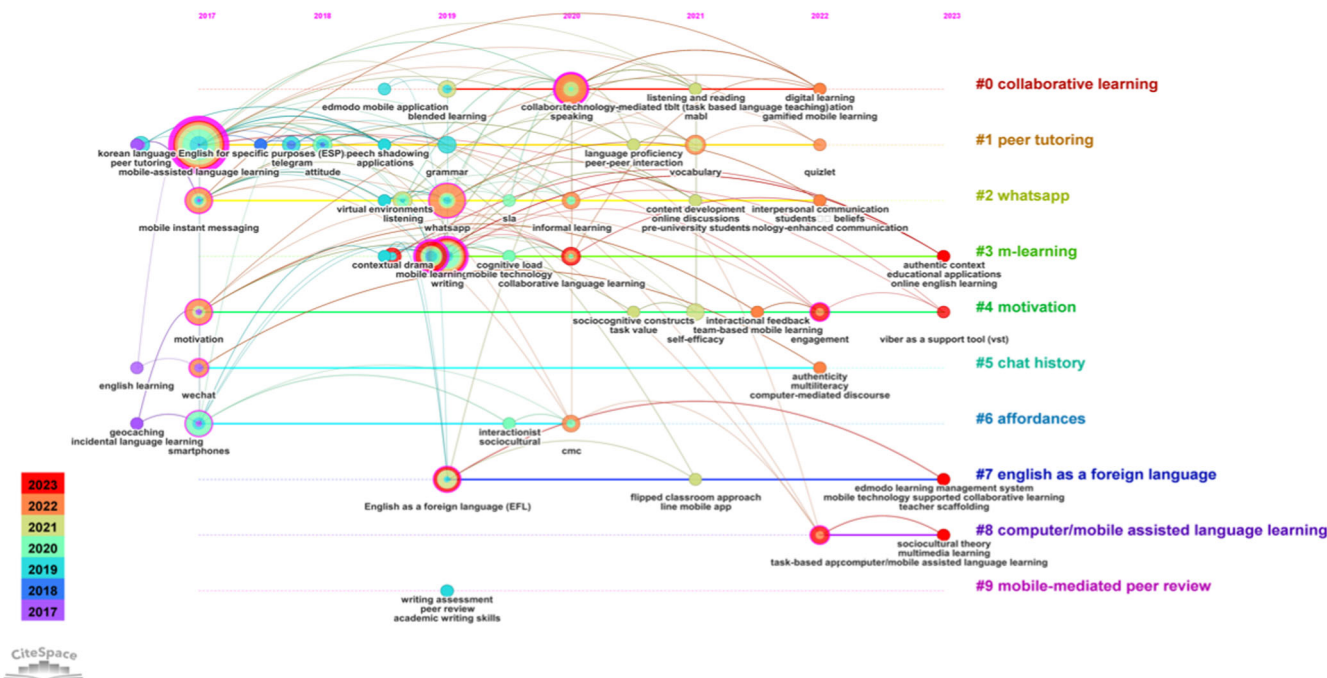


Fig. 18 Timeline view of the keywords co-occurrence network.

with engagement in recent studies. The emphasis on affordances was notable from 2017 to 2020, with current research attention shifting towards interpersonal communication, engagement, authentic context learning, theoretical foundations supporting C-MALL (e.g., sociocultural theory), and exploring the integration of pedagogical approaches into teaching design (e.g., task-based approach).

Research frontiers of C-MALL empirical studies. To further identify the frontier topics and research trends in C-MALL practice, a keyword citation burst analysis was conducted and visualized using the CiteSpace algorithm based on their frequency of occurrence. Figure 19 presents the top 25 keywords with the strongest citation bursts, along with their strength, earliest appearance year, and beginning and ending years of bursts. The blue line represents the entire study period, whereas the red line depicts the duration of the citation burst, indicating the shift in research focus (Wang et al., 2020).

Prior to 2019, burst keywords were predominantly associated with smartphone technology (beginning in 2017) and investigating its affordances in supporting English learning (beginning in 2017) and English for Specific Purposes (ESP) courses (beginning in 2018), such as instant messenger (beginning in 2017) with a 2-year burst duration. Peer-tutoring (beginning in 2017) was the primary form of cooperative learning and lasted for three years.

Subsequently, from 2019 onwards, C-MALL empirical studies gradually transitioned towards examining its effectiveness in enhancing specific language skills, such as writing (beginning in 2019), grammar (beginning in 2019), and listening (2019–2021). Writing received significant attention, including writing performance (beginning in 2020), EFL writing teaching (beginning in 2020), and collaborative writing (beginning in 2020). Notably, while cooperative learning experienced a burst in 2018, collaborative learning started to surge in 2020 and persisted for four years. Although cooperative learning and collaborative learning were once used interchangeably, researchers have begun to differentiate between the two concepts in recent years, highlighting collaboration as mutual reliance among individuals working towards a shared outcome, distinct from cooperation’s

division and completion approach (Roberts, 2004). The shift in focus from cooperative to collaborative learning in C-MALL studies may indicate a deeper comprehension of collaborative learning and advancements in terminology clarification.

Furthermore, 2020, keywords such as attitude in writing, cognitive load, and social presence exhibited bursts, potentially linked to the influential article by Jiang and Zhang (2020). Their study framed C-MALL research within the Community of Inquiry (CoI) framework, widely employed in e-learning, online learning, or distance learning to facilitate learners’ collaborative knowledge construction. They demonstrated that strengthening social presence activities could reduce students’ cognitive load and enhance their writing performance.

Since 2022, several new topics have emerged as the current trend in C-MALL empirical studies, such as learners’ motivation, interactional feedback, design-based research (DBR), and group chat. Among these, the topic of Covid-19 emerged due to the global pandemic that began at the end of 2019. However, its burst three years later indicated a delay in C-MALL studies in response to unexpected events.

Additionally, the research focus has shifted from exploring affordances to enhancing skills and incorporating design-based research (DBR) practices (initiated in 2022 and ongoing). This shift aligns with the call made by Kukulska-Hulme and Viberg (2018) to integrate pedagogical principles more systematically into language learning designs. They also encouraged future studies to consider learners’ interactions and communications when designing C-MALL activities. Consequently, an increasing number of C-MALL studies have started to analyze students’ dynamic interactions through conversational threads analysis (Syah, 2020; Tong, Yin, and Tsung, 2022; Imamyartha et al., 2022). Therefore, the keyword “group chat” began to surge in popularity in 2022.

Implications

Based on the outcomes of this review, the authors propose several implications for forthcoming studies concerning research and pedagogical practice.

Top 25 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	2017-2023
peer tutoring	2017	0.82	2017	2019	
instant messenger	2017	0.65	2017	2019	
English learning	2017	0.65	2017	2017	
smartphone technology	2017	0.65	2017	2017	
cooperative learning	2018	0.68	2018	2018	
ESP course	2018	0.68	2018	2018	
writing	2019	1.32	2019	2020	
grammar	2019	0.99	2019	2019	
mobile learning	2019	0.54	2019	2019	
listening	2019	0.55	2019	2021	
mobile assisted language learning	2017	1.81	2020	2020	
collaborative learning	2020	1.04	2020	2023	
attitude in writing	2020	0.59	2020	2020	
writing performance	2020	0.59	2020	2020	
EFL writing teaching	2020	0.59	2020	2020	
cognitive load	2020	0.59	2020	2020	
social presence	2020	0.59	2020	2020	
collaborative writing	2020	0.59	2020	2020	
learner motivation	2022	0.5	2022	2023	
interactional feedback	2022	0.5	2022	2023	
design-based research (DBR)	2022	0.5	2022	2023	
covid 19	2022	0.5	2022	2023	
college writing	2022	0.5	2022	2023	
business English course	2022	0.5	2022	2023	
group chat	2022	0.5	2022	2023	

Fig. 19 Top 25 keywords with the strongest citation bursts.

Regarding future research, firstly, beyond higher education, students from various education levels merit equal attention, particularly young learners, if given enough ethical consideration to ensure their educational experience safe, secure, and beneficial. Furthermore, considering the era of lifelong learning, the learning needs of working adults should also be addressed. Secondly, given the prevalent use of mixed methods and quantitative studies in C-MALL empirical research, and the common utilization of quasi-experimental research designs for maintaining the integrity and the authenticity of real educational settings, incorporating more innovative methods (e.g., group chat analysis, learning behavior analysis) is recommended to delve deeper into the essence of the C-MALL learning process. Along with investigating the impacts of C-MALL practices through inferential statistics, attention should also be given to affective factors that could influence effectiveness, such as learners’ motivation and engagement. Thirdly, due to the small sample sizes and short intervention durations in most reviewed C-MALL studies, it is advisable to include larger sample sizes and longer intervention periods to enhance the reliability and generalizability of the findings.

Concerning future pedagogical practices, initially, in terms of enhancing students’ language skills and strengthening their individual language skills, emphasis should be placed on integrated language applications. Furthermore, students’ development of advanced competencies like critical thinking, pragmatic knowledge, and intercultural communication should be considered. Secondly, pedagogical principles and second language acquisition theories should inform teaching activities’ design. The selection of mobile learning technologies should be based on a comprehensive understanding of the educational affordances of these technologies. The purpose of using technologies in

education is to enhance the teaching and learning process rather than using them merely for technology’s sake. Lastly, students should be positioned at the core of their own learning process, with the autonomy to choose learning materials and behaviors. To boost students’ motivation to learn and augment their learning autonomy, they should be encouraged to act as co-designers when creating C-MALL activities.

Conclusion

This systematic literature review employed an integrated methodology combining bibliometric, content, and scientometric analyses to achieve two objectives: to provide a holistic landscape of the previous C-MALL empirical research, and to illustrate the development trends and directions for future C-MALL studies.

For the first objective, bibliometric analysis and content analysis were used to provide a comprehensive view of previous C-MALL empirical studies from both macro and micro perspectives. Bibliometric analysis focused on the macro distributive features of the reviewed studies. The results showed that with regard to yearly publications, C-MALL empirical studies demonstrated a steady increase since its appearance from 2015 to 2018. Its explosive growth started in 2019, and such enthusiasm remained until the search date. Concerning country/region distribution, researchers from Asian countries have shown great enthusiasm for implementing C-MALL in educational contexts. However, considering the journals in which these previous C-MALL empirical studies were published, there is still a need for more high-quality publications in this field.

The content analysis offered a micro view of C-MALL practices from context, methodology, C-MALL design, and effectiveness.

Most of the reviewed C-MALL empirical research was conducted in higher education, with less focus on groups beyond the campus. Language in C-MALL was mainly English as L2/FL, but studies on other languages as L2/FL teaching and learning demonstrated language pluralism. Regarding research methodology, the majority of the reviewed C-MALL studies preferred mixed methods or quantitative studies, short-term (<10 weeks) duration, and small sample sizes (<30). Within C-MALL design, studies mainly emphasized writing and speaking skills, encouraging collaboration and communication, as well as integrated language skills emphasizing language usage. Other aspects like motivation, engagement, and learning achievement also attracted researchers' attention. Smartphones were the most commonly used mobile device in C-MALL empirical studies, with social media-based collaborative learning systems like WhatsApp being extensively utilized to facilitate learners' collaborative activities. In terms of group size, there was no specific preference; it depended on the collaborative activities and task designs. In terms of effectiveness, most studies using inferential statistics showed the positive impact of C-MALL practice on various aspects of language learning.

For the second objective, the authors conducted a scientometric analysis using CiteSpace to visualize keyword co-occurrence networks and keyword bursts. The timeline view of keyword clusters and bursts revealed the shift of research focus from exploring the affordances of mobile devices to support collaboration to utilizing mobile devices to promote language skills and emphasizing teaching design and affective factors like motivation and engagement in the C-MALL process. Thus, the authors call for more scientifically designed C-MALL empirical studies based on pedagogical theories and for learners' motivation and engagement throughout the process to be considered.

However, this review has limitations. The first limitation is that despite an extensive search across databases, the subjective nature of the search strings might have introduced selection bias, potentially overlooking some relevant studies. This may limit the findings' ability to represent the entire body of previous literature comprehensively. Therefore, it is recommended that future research develop comprehensive search strings that include a broader range of relevant keywords and consider variations in terminology. The second limitation is that due to the specific topic focus of the SLR, it only allows a limited number of entries. We apologize for solely focusing on peer-reviewed C-MALL empirical articles and relevant dissertations, thereby excluding other forms of evidence such as notable books, reviews, and conference proceedings. The third limitation concerns scientometric analysis, as the authors only analyzed data retrieved from Scopus due to technical difficulties in analyzing data across databases. The authors suggest that future researchers learn to integrate data from different databases or utilize more advanced visualization tools to increase the validity of the analysis.

Data availability

The datasets generated or analyzed during this study, mainly the 72 included articles and dissertations, are available in the Harvard Dataverse repository, <https://doi.org/10.7910/DVN/O05Z6G>.

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Author contributions

Pingping Guo: conceptualization, methodology, data curation, and analysis, writing an original draft and revising; Joanna Joseph Jeyaraj: methodology, data validation, revising, supervision; Abu Bakar Razali: methodology, data validation, revising, supervision.

Competing interests

The authors declare no competing interests.

Ethical approval

Ethical approval was not required as the study did not involve human participants.

Informed consent

This study did not require informed consent because it used publicly available data that did not involve human individuals.

Additional information

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