Intelligent of CALL in EFL Context (2014-2024): Bibliometric Insights, Pedagogical Gaps, and Human-AI Collaboration

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ABSTRACT

Objective: Over the past decade, research on Intelligent Computer-Assisted Language Learning (ICALL) in English as a Foreign Language (EFL) contexts has expanded rapidly alongside advances in artificial intelligence. However, no comprehensive bibliometric study has systematically mapped how ICALL research themes have evolved, intersected, or revealed gaps, limiting scholarly understanding of emerging trends and pedagogical implications. This study addresses this gap by examining the thematic development and knowledge structures of ICALL research in EFL contexts. Method: A systematic bibliometric analysis was conducted on 986 publications published between 2014 and 2024. Data were retrieved from Web of Science, Scopus, and Google Scholar using the Publish or Perish tool. A PRISMA-inspired screening procedure ensured data quality and relevance, and VOSviewer software was used to generate network, overlay, and density visualizations to reveal research clusters, thematic linkages, and temporal evolution. Results: The analysis showed a sharp post-2019 increase in ICALL-related publications, largely driven by AI-assisted tools and personalized learning environments. Three central research nexuses were identified: ICALL–Intelligence, ICALL–Language Education, and ICALL–Pedagogy. While the first two clusters have been widely explored, the pedagogical dimension remains underrepresented despite its critical role in aligning technology with instructional design and learner development. Novelty: This study contributes by systematically mapping a decade of ICALL–EFL research, highlighting both saturated and underexplored areas. It calls for embedding human cognitive capacities—such as critical thinking, creativity, and problem-solving—into ICALL design, and advocates pedagogically grounded Human–AI collaborative models to foster ethical, meaningful, and learner-centered EFL education.

INTRODUCTION

Over the past decade, research on Intelligent Computer-Assisted Language Learning (ICALL) in English as a Foreign Language (EFL) contexts has gained increasing attention alongside rapid advancements in artificial intelligence technologies [1][2][3]. These innovations have transformed language education by enabling automated feedback, adaptive instruction, and personalized learning pathways that were previously unattainable [4][5][6]. As ICALL applications expand in scope and complexity, understanding how this field has evolved thematically and conceptually becomes essential for guiding future research and pedagogical integration [7][8].

However, a comprehensive bibliometric mapping of ICALL–EFL scholarship has not yet been undertaken. The absence of such mapping reduces scholars' capacity to pinpoint true novelty, identify underexplored intersections, and detect thematic blind spots that could shape future directions in the field [9][10]. Bibliometric analysis provides a powerful way to address this gap by systematically examining publication patterns, thematic linkages, and the intellectual structure of a research domain [10][11]. This

approach makes it possible to reveal how subfields—such as the integration of instructional design within ICALL-supported EFL writing—remain loosely connected, highlighting areas that warrant further investigation [8].

Previous bibliometric efforts related to ICALL have tended to adopt relatively narrow foci. Many have concentrated on AI-supported tools and their impact on student performance, confidence, or learning barriers [12][13][14][15][16]. Others have explored teachers' and learners' perceptions of AI integration in EFL education but rarely extended their analysis to capture broader thematic clusters or conceptual networks [17][15][18]. As a result, the field still lacks a macroscopic understanding of how ICALL research themes intersect and evolve over time.

Conducting a systematic bibliometric study offers at least two key advantages. First, it clarifies which domains are already saturated with research and which remain underrepresented, allowing the detection of "unlinked nodes" within ICALL–EFL scholarship [19]. For example, if little evidence links ICALL with EFL writing pedagogy, this absence itself signals an opportunity for new investigation. Second, it reveals the saturation of certain research themes, helping scholars redirect efforts from repeatedly studied topics toward less explored intersections [11][20][21].

Despite these benefits, bibliometric methods remain underutilized in ICALL–EFL scholarship. Much of the existing research has yet to examine the thematic evolution of the field or uncover the conceptual "nexus" linking its diverse domains.

To respond to this gap, the present study conducts a systematic bibliometric analysis to: (1) map the thematic structures and interconnections within ICALL–EFL research from 2014 to 2024, (2) identify the most recent and emerging topics, and (3) evaluate publication density and influence patterns. Using data retrieved from Google Scholar, Scopus, and Web of Science (via Publish or Perish), a PRISMA-inspired screening process ensured data integrity, and VOSviewer was employed to generate network, overlay, and density visualizations.

Beyond mapping research clusters, this study also provides citation metrics and a short review of top-ranked articles to contextualize the observed patterns. By doing so, it supports more informed research planning and encourages the development of pedagogically grounded investigations into intelligent language learning technologies. Accordingly, this study is guided by the following research question: How can pedagogically grounded Human–AI collaborative models be designed and implemented in ICALL environments to foster higher-order skills (e.g., critical thinking, creativity, problem-solving) in EFL learning?

RESEARCH METHOD

This study employed a bibliometric approach within a descriptive design to examine the intellectual landscape and thematic development of Intelligent Computer-Assisted Language Learning (ICALL) in English as a Foreign Language (EFL) contexts. Bibliometric analysis was chosen because it enables the visualization of large-scale publishing patterns, citation networks, and thematic connections that are often difficult to capture through traditional literature reviews. The main objective was to trace the evolution of ICALL–EFL research over the past decade, identify areas that have been extensively explored, and highlight domains that remain underrepresented, particularly those related to pedagogical applications in language education.

The dataset was compiled from three major databases: Web of Science (WoS), Scopus, and Google Scholar. WoS and Scopus were selected for their rigorous indexing and citation-tracking standards, while Google Scholar was included to broaden the coverage by capturing conference proceedings and book chapters that have significantly contributed to scholarly discussions. This combination ensured both breadth and depth, reducing the likelihood of overlooking influential works.

Data were retrieved using the Publish or Perish (PoP) software with the Boolean query: ("ICALL" OR "Intelligent Computer-Assisted Language Learning") AND ("EFL" OR "English as a Foreign Language"). The search targeted studies published between 2014 and 2024, a period chosen to capture long-term trends as well as the rapid expansion of AI-driven and digital learning during the COVID-19 era. Including this wider timeframe also allowed earlier, pre-pandemic research to be incorporated, which narrower reviews often exclude.

The initial search produced 990 records, which were exported in .ris format for cleaning and analysis. A two-step process was conducted: automated duplicate removal through PoP, followed by manual verification to ensure accuracy. After excluding 12 duplicates, 986 unique publications remained. To maintain consistency and quality, only English-language works published in peer-reviewed outlets—journal articles, conference papers, reviews, and book chapters—were included. Non-scholarly materials, unpublished reports, and works in other languages were excluded. These criteria ensured both the reliability and diversity of the dataset, while also capturing the range of contributions that continue to shape ICALL–EFL scholarship.
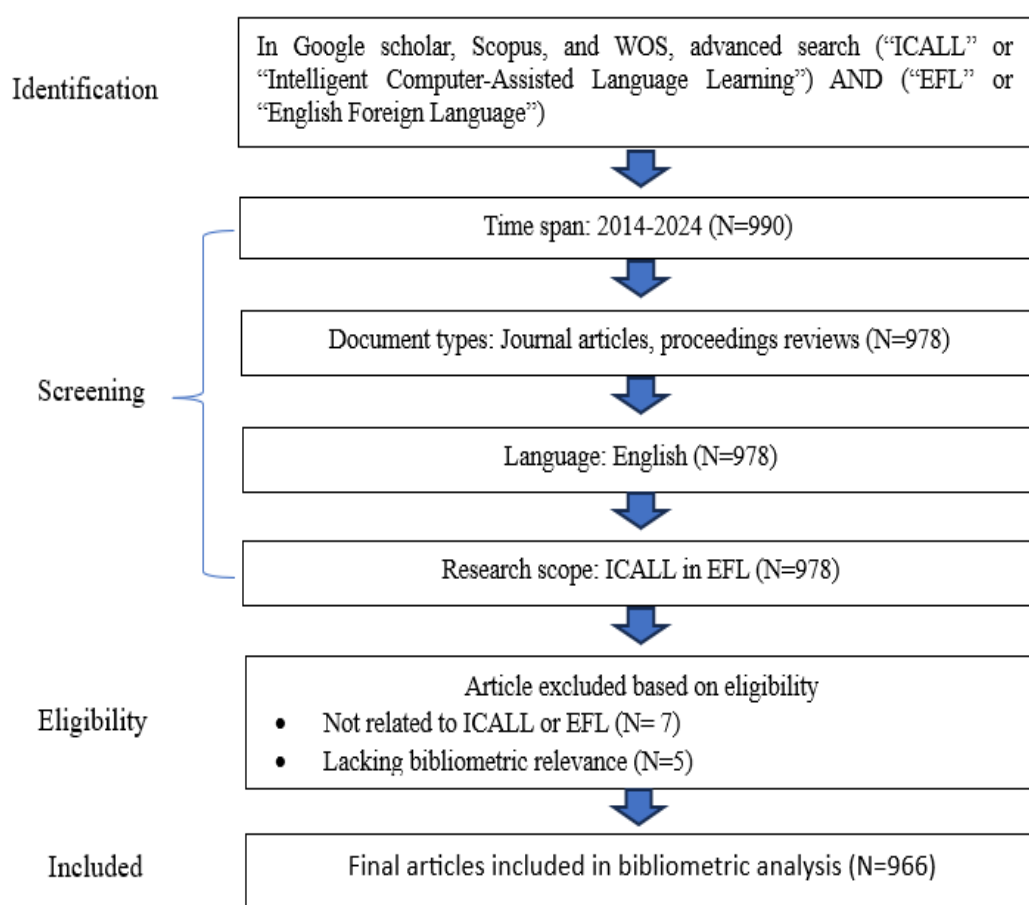

Figure 1. PRISMA Flow of Article Identification and Selection (2014-2024).

The refined dataset was analyzed using VOSviewer, a widely recognized tool for generating bibliometric maps and visual representations. Three forms of analysis were carried out. The network mapping highlighted the co-occurrence of keywords, enabling the identification of thematic clusters and the visualization of conceptual relationships across the body of literature. The overlay visualization traced the chronological progression of research themes, shedding light on shifts in scholarly focus and highlighting emerging directions. The density visualization revealed areas with concentrated publication activity, pointing to dominant themes while also exposing underexplored topics.

Together, these visualizations provided a multidimensional view of ICALL–EFL research. They not only helped identify influential clusters but also uncovered topical gaps and suggested promising areas for further exploration. This methodological approach ensured rigor and replicability while offering a solid analytical foundation for understanding how ICALL research has evolved in relation to language education, pedagogy, and human–AI collaboration.

RESULTS AND DISCUSSION
Results

A well-presented results section coupled with a convincing discussion will definitely prove the novelty and importance of your study. It should provide a concise and precise description of the experimental results, their interpretation, as well as the experimental conclusions that can be drawn.

This study expelled 11 duplicate records among the 998 relevant documents found in the Web of Science, Scopus and Google Scholar 2014-2024 database under the operated keywords "ICALL" or "Intelligent Computer-Assisted Language" and "EFL" or "English as Foreign Language". Table 2 shows the citation metrics of the 986 documents.

Table 1. Citation Metrics of the Involved Documents.

Publication years	2014-2024
Citation years	10 years
Papers	986
Citations	24801
Cites/year	2480.10
Cites/paper	25.15
Cites/author	15671.47
Papers/authors	687.57
Authors/papers	1.90
h-index	72
g-index	142
hI, norm	60
hI, annual	6.00
hA-index	33

The documents were distributed across a ten-year period (2014–2024) and showed diverse annual growth patterns. From 2014 to 2015, the number of publications on ICALL in EFL increased by 32.35%, indicating a surge of initial interest in integrating intelligent technologies into language learning. However, between 2015 and 2016, publication output declined by 7.93%, accompanied by a decrease in the number of Scopus-indexed journals publishing on this topic. From 2016 to 2018, publication numbers rose again at

an average annual growth rate of 14.39%, suggesting a gradual consolidation of ICALL research as an emerging subfield within technology-enhanced language learning. A slight decline followed between 2018 and 2019 (–16.21%), which was likely related to the transition from exploratory studies to more implementation-focused designs. Notably, the number of publications grew substantially from 2019 to 2023, with an average annual increase of 16.84%, reflecting the accelerated adoption of AI-based instructional tools during and after the COVID-19 pandemic [1][4][3][16]. Although the dataset shows a slight decline from 2023 to 2024, this trend is considered reasonable because only four months of 2024 were covered at the time of data collection.

This overall growth trajectory aligns with previous observations that ICALL-related research has expanded significantly in parallel with advances in artificial intelligence and digital learning technologies [10][22][8], indicating a sustained and increasing scholarly interest in the field. Figure 1 illustrates the annual growth of publications in ICALL–EFL over the ten-year period.
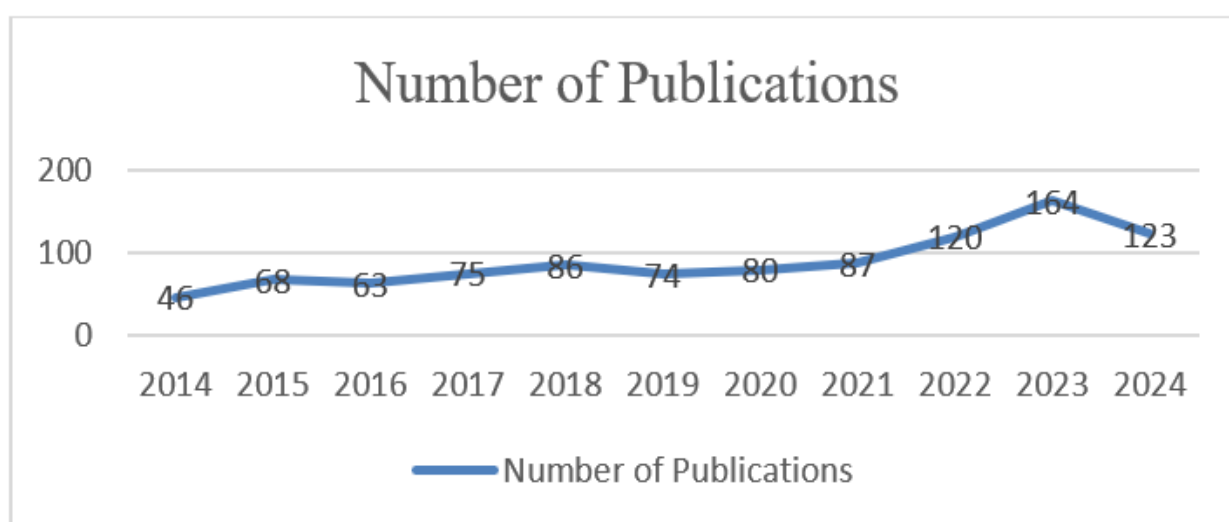

Figure 2. Publications in the field of ICALL in EFL from 2014 to 2024.

Bibliometrics Analysis Results

This study portrayed three mappings, namely network, overlay, and density visualizations. Figure 2 shows the overall network visualization.
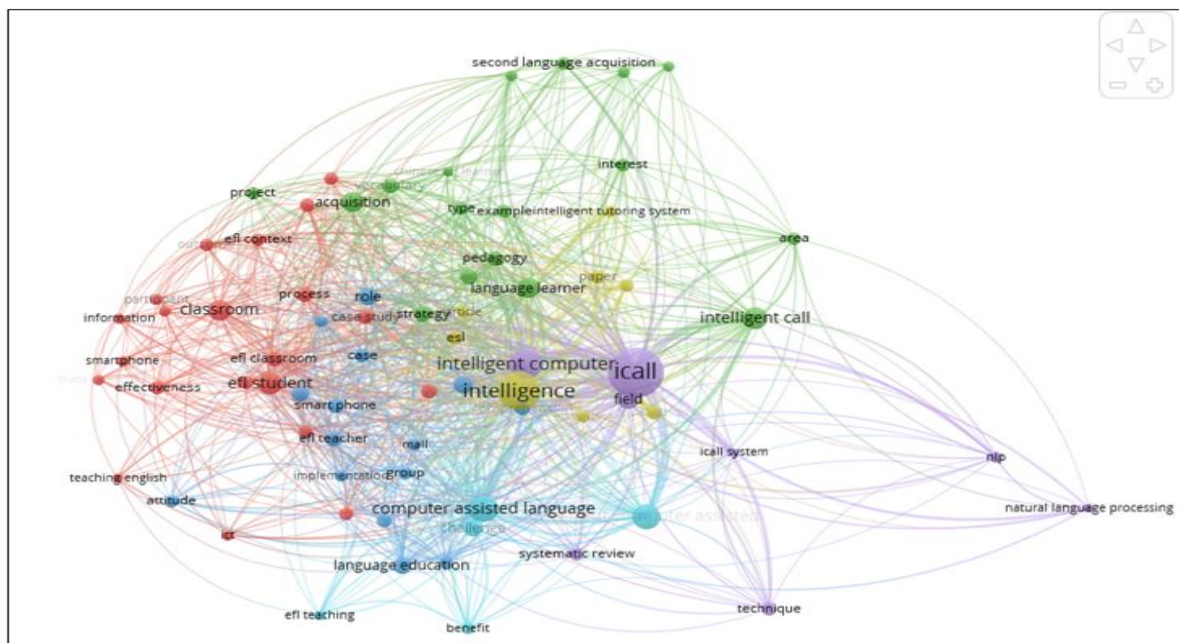
Figure 3. Overall theme links in the field of ICALL in EFL from 2014 to 2024.

Figure 3 displays nodes as the representation of the research themes and edges as the representation of the links. Among them, five highly occurring themes—ICALL, intelligence, intelligent computer, computer-assisted language, and EFL students— emerged as the largest nodes, indicating their centrality in the field. The themes of intelligence, intelligent computer, and computer-assisted language were largely overlapping, sharing sub-themes such as natural language processing, artificial intelligence, machine learning, deep learning, AI-based tools, gamification, mobile learning, and web-based learning. These findings are consistent with earlier studies that highlighted the rapid integration of AI-driven technologies, mobile learning, and web-based platforms in language education [4][3][16], as well as the increasing emphasis on intelligent tutoring systems and personalization in ICALL environments [23][24][16]. The EFL student theme primarily referred to research focusing on learning performance, learning strategies, personalized learning, motivation, technology use, and autonomous learning, aligning with prior work that demonstrated how AI-based tools can enhance students' motivation, self-regulated learning, and critical thinking in EFL contexts [25][26][16].

In addition, according to Figure 2, there were seventy-four research themes with 960 links in the field of ICALL in EFL from the Web of Science, Scopus, and Google Scholar (2014–2024). These themes were categorized into six clusters represented by different colors. Since VOSviewer did not provide explicit cluster names, the present study identified their foci based on their constituent nodes. The red cluster centered on artificial intelligence and technology integration in language learning, including nodes such as intelligence, intelligent CALL, and computer-assisted language learning, which aligns with previous systematic reviews emphasizing the growing role of AI and ICALL in language education [22][8]. The green cluster focused on language acquisition and development, containing nodes labeled second language acquisition, language development, and bilingualism—corroborating studies showing how ICALL supports vocabulary acquisition and grammar learning through feedback and memory-related mechanisms [12][27][5][28][29]. The deep blue cluster reflected computational linguistics and processing, including nodes such as natural language processing, language

recognition, and speech recognition, which have been widely examined in studies applying NLP and speech technologies in ICALL systems [30][31][32][6][33]. The purple cluster represented the use of ICALL in language education and systematic reviews of educational methods, supported by prior bibliometric and systematic studies consolidating evidence of AI applications in ELT [10][19][22][20][8]. The light blue cluster covered methods and techniques in language teaching, including nodes labeled teaching methods, language instruction, and EFL teaching, echoing earlier research demonstrating the effectiveness of AI-based feedback tools and NLP-driven platforms to enhance EFL writing and speaking instruction [34][35][36][37][38]. Finally, the yellow cluster pertained to theoretical or foundational aspects of language studies, as indicated by nodes such as linguistics and corpus, which aligns with foundational work on grammar-based ICALL systems, multimodal transcription, and corpus-informed language learning strategies [39][40][41].

Figure 1 further shows that these clusters are densely interconnected, reflecting how diverse research strands in ICALL–EFL scholarship are thematically linked and continue to shape the intellectual structure of the field.
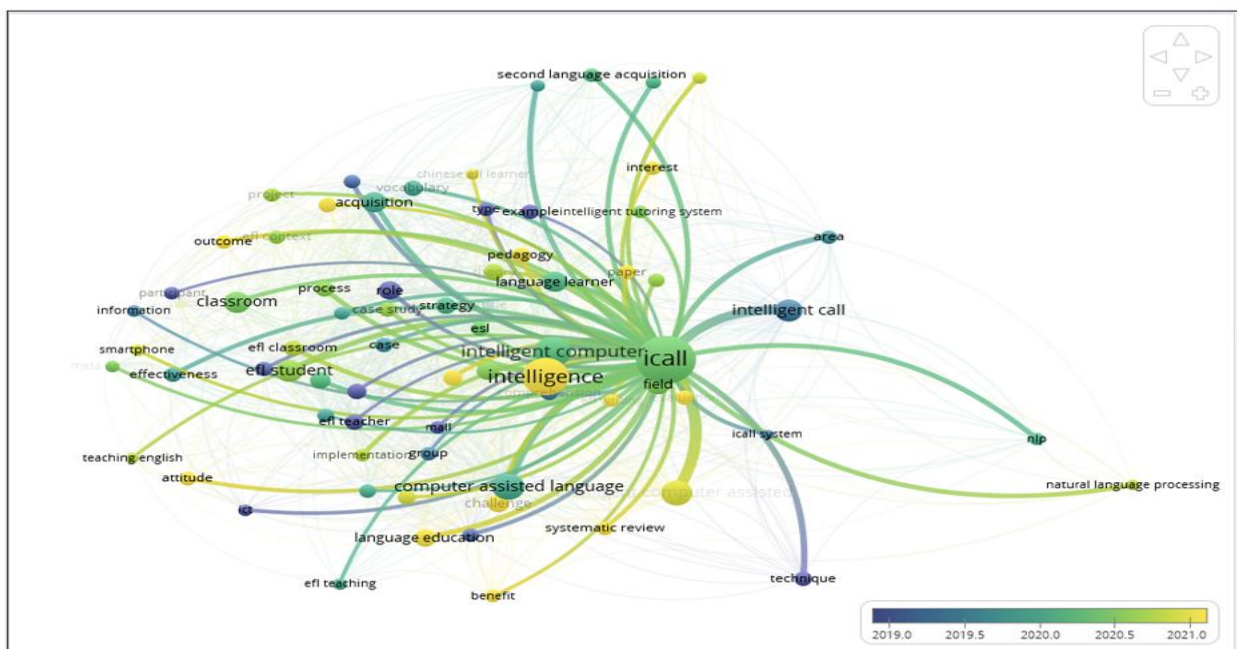

Figure 4. Overlay visualization of the recent research topics of ICALL in EFL.

Even though each cluster was already interconnected through specific thematic links, an overlay visualization was employed to identify the most recent research topics. Because this study focused on ICALL, the overlay visualization was further specified to the ICALL node. As shown in Figure 3, the yellow color highlights the most recent topics in the ICALL–EFL field. Several larger yellow nodes were directly connected to the ICALL node, particularly those labeled intelligence (AI-assisted tools), language education, and pedagogy. This indicates that the most recent and high-interest research nexuses are ICALL–intelligence, ICALL–language education, and ICALL–pedagogy.

The strong presence of the ICALL–intelligence nexus aligns with the growing number of studies emphasizing the use of AI-based tools, machine learning, and NLP-driven feedback systems in EFL classrooms [23][4][32][6][16]. Likewise, the ICALL–language education nexus reflects extensive research on the application of intelligent

tutoring systems and adaptive learning platforms to enhance EFL students' learning outcomes, motivation, and critical thinking [34][36][24][37][8].

However, the ICALL–pedagogy nexus appeared as a smaller node compared to the other two, suggesting that while pedagogically oriented ICALL studies have begun to emerge, their number remains relatively limited. This scarcity echoes prior observations that the pedagogical dimension of ICALL has been underrepresented in the literature despite its crucial role in integrating intelligent systems with instructional design and human cognitive development [25][18][3][8]. Therefore, the findings imply that ICALL–pedagogy remains a promising yet underexplored area that warrants further investigation.

To verify this pattern, Figure 3 also presents a density visualization map, which illustrates the relative publication intensity of each theme and confirms the lower density surrounding the ICALL–pedagogy node compared to the denser ICALL–intelligence and ICALL–language education nodes.
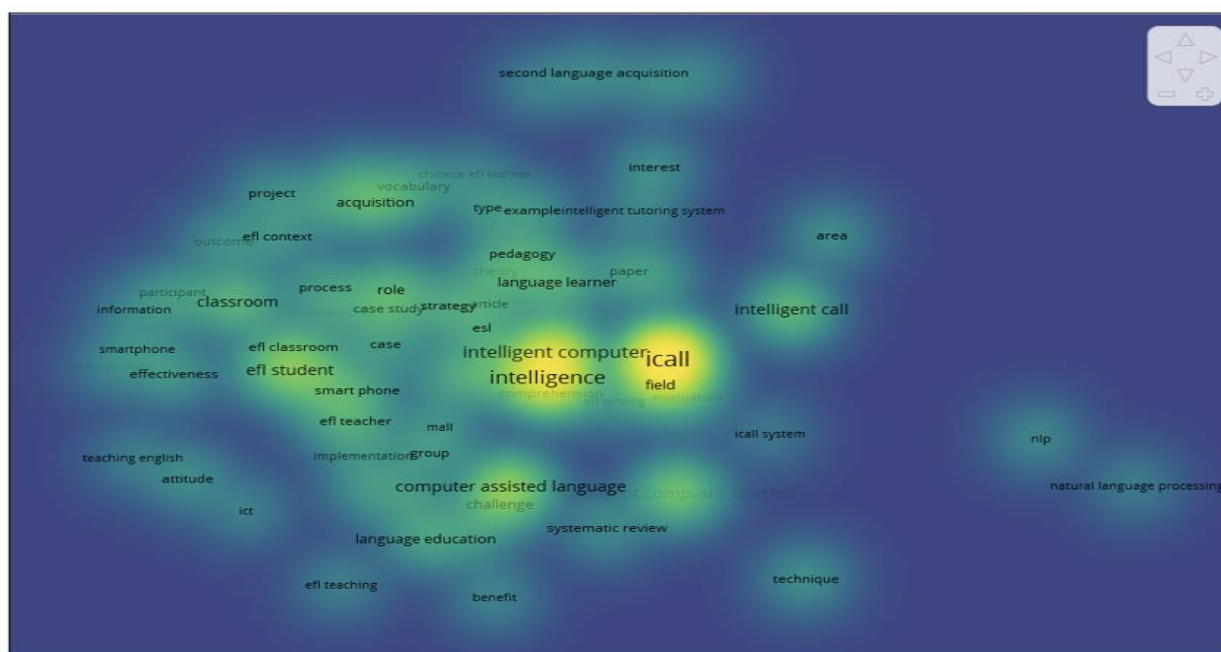

Figure 5. Density of publications in each theme.

Figure 4 illustrates that the themes of ICALL and intelligence had the highest publication density in the ICALL–EFL field, as indicated by their stronger yellow color. These themes also appeared as the most recent research foci, as confirmed by the overlay visualization in Figure 3. This finding reflects the considerable scholarly attention that has been devoted to developing AI-assisted tools, machine learning systems, and NLP-based feedback mechanisms to enhance language learning [23][4][32][6][16]. Numerous studies have explored how such intelligent technologies improve EFL learners' writing, speaking, and reading performance, as well as their motivation and self-regulated learning capacities [34][36][24][37][8].

However, because these themes are already saturated with dense publications, they may no longer offer substantial opportunities for novelty-driven contributions. In contrast, the ICALL–pedagogy theme appeared with a much lower density (represented by its lighter color in Figure 4) despite being classified as a recent research topic in Figure 3. This aligns with previous observations that the pedagogical dimension of ICALL

remains underrepresented, even though it is crucial for integrating intelligent systems with instructional design and fostering higher-order cognitive skills such as critical thinking and creativity [25][18][3][8].

Accordingly, based on the combined evidence from Figures 3 and 4, ICALL–pedagogy is recommended as a promising avenue for future research, offering substantial potential for theoretical and practical contributions to the field.

Short Review of Top Three-ranked Publications

Among the 986 publications analyzed, this study identified the top-ranked documents to highlight the most influential topics in the field of Intelligent Computer-Assisted Language Learning (ICALL) within English as a Foreign Language (EFL) contexts.

The first-ranked document, cited 63 times per year, was *"Instructional Design and Learning Outcomes of Intelligent Computer-Assisted Language Learning: Systematic Review in the Field"* by Weng and Chiu (2023) [8]. This systematic review examined the growing scholarly interest in ICALL-based instruction and applied the First Principles of Instruction framework to propose design guidelines for ICALL environments. Weng and Chiu argued that ICALL environments can significantly enhance learning by providing automated feedback, intelligent tutoring, and personalized learning experiences. However, they emphasized that the instructional design of ICALL systems still requires further investigation, particularly in terms of integrating critical thinking components into language learning tasks.

The second-ranked document was *"Intelligent Computer-Assisted Language Learning in the English as a Foreign Language Classroom"* by Newvine (2023) [42]. Complementing Weng and Chiu's findings, Newvine explored the application of AI-based programs powered by natural language processing (NLP)—such as Wordbricks and Question Generator—to support basic linguistic instruction, particularly translation tasks. His study showed that ICALL-based teaching improved students' translation skills more effectively than traditional instruction. Nevertheless, students encountered challenges in operating the programs and understanding the rationale behind the materials. Newvine suggested that future research should establish a middle ground between ICALL applications and the human aspects of language learning, thereby fostering a balanced integration of artificial and human intelligence.

The third-ranked document was *"Individual Differences and Instructed Second Language Acquisition: Insights from Intelligent Computer-Assisted Language Learning"* by Ruiz Hernández (2019) [27]. This study conducted a web-based ICALL-mediated experiment to examine the relationship between learners' working memory, declarative memory, and their acquisition of English phrasal verbs. The findings revealed that the ICALL-based instruction influenced students' working memory but not their declarative memory. Ruiz Hernández concluded that ICALL may interact with individual cognitive differences, and further research should continue exploring its effects on other cognitive domains.

Taken together, these three top-cited studies indicate that research on ICALL has increasingly emphasized instructional models and pedagogical integration, suggesting that the pedagogical dimension constitutes a highly relevant and emerging area within current ICALL scholarship.

Discussion

Research on Intelligent Computer-Assisted Language Learning (ICALL) in English as a Foreign Language (EFL) contexts has grown steadily over the past decade and has accelerated markedly during the past three years. The bibliometric analysis revealed that publications increased from 87 in 2021 to 120 in 2022, and further to 164 in 2023, with 123 already indexed by September 2024. This upward trajectory is expected to continue and can be attributed to two main drivers.

The first is the rapid advancement of artificial intelligence (AI) tools, which have transformed language learning by making it more adaptive, autonomous, and personalized [43][44]. Such technologies are particularly relevant for Generation Alpha learners, who increasingly seek independence and customized learning experiences [6]. The second factor is the proliferation of generative AI applications—such as ChatGPT, Perplexity, Jenni AI, Quillbot, and DeepL—which have reshaped learners' engagement with English [29]. While intelligent tools provide instant language support and improve linguistic accuracy, they also raise pedagogical concerns when learners become overly reliant on them, thereby diminishing their cognitive engagement. This dual nature—empowering on one hand yet potentially limiting on the other—has made ICALL a central topic in contemporary academic discourse.

The rapid expansion of ICALL scholarship is also evident from its citation record. From the 986 publications analyzed, a total of 24,801 citations were identified, averaging about 2,480 citations per year or 25 per paper. This surge is closely connected to the COVID-19 pandemic, which accelerated the global adoption of digital technologies and expanded the educational use of AI [45][38]. Platforms such as Zoom, Google Meet, and various learning management systems became indispensable, intensifying interest in AI-based instruction. During this period, Ashe and Lopez [46] and Zhou and Wei [41] emphasized the urgent need for teachers to develop stronger technological competencies to support both synchronous and asynchronous learning. This study reflects that historical turning point, showing that the steepest rise in ICALL publications occurred between 2019 and 2023, when many education systems worldwide transitioned toward hybrid and digital formats.

Beyond quantitative growth, this study also mapped the thematic structure of ICALL–EFL research. Six dominant clusters were identified, encompassing: (1) technology in language education, (2) second language acquisition, (3) computational linguistics, (4) ICALL-focused reviews, (5) teaching strategies, and (6) theoretical foundations. Within these clusters, 74 distinct themes emerged, with recurring keywords such as ICALL, intelligence, intelligent computer, computer-assisted language, and EFL students.

Much of the literature has focused on applying AI to the four language skills. In writing, tools such as Grammarly and AI-based feedback systems support grammatical accuracy, coherence, and self-editing [47][34]. For speaking, ICALL has been shown to enhance pronunciation and fluency [48][36][37]. Applications designed to support reading improve comprehension and strengthen syntactic awareness [49][50], while listening platforms encourage learners to take greater ownership of their auditory practice [4][6]. Collectively, these studies reaffirm ICALL's contribution to developing language competence across all four skills [1][51][42][27].

From this body of scholarship, three central strands of research can be identified: ICALL–Intelligence, ICALL–Language Education, and ICALL–Pedagogy. The ICALL–Intelligence strand highlights AI-driven innovations that rely on natural language

processing and deep learning [30][6]. The ICALL–Language Education strand emphasizes practical applications, showing how intelligent systems can support grammar [52], vocabulary development [53], and pronunciation training [37][54]. In contrast, the ICALL–Pedagogy strand addresses instructional design principles, such as Merrill's First Principles of Instruction [8], alongside broader digital learning frameworks [55].

Despite its relevance, the pedagogical dimension remains less developed compared to the other two strands. This imbalance likely stems from structural factors: ICALL research has been predominantly shaped by computer science perspectives that prioritize algorithmic performance, many educators lack preparation to effectively integrate AI into classroom practice, and academic publishing continues to favor technological novelty over theoretically grounded inquiry. Consequently, technological progress has outpaced pedagogical innovation, leaving pedagogy as the weakest and most underrepresented dimension within current ICALL research [25][18][3][8].

The analysis also identified several critical gaps in the current ICALL–EFL research landscape. Although numerous studies have examined the use of AI-based tools, relatively few have explored how ICALL can be systematically embedded into instructional design or directly linked to measurable learning outcomes. Scholars such as Alsadoon [56] and Voss [57] have emphasized the need for stronger alignment between ICALL environments and higher-order learning goals, including argumentative writing, critical reasoning, and cognitive flexibility. While Newvine [42] demonstrated that ICALL applications can be effective for specialized tasks such as translation, such findings often lack broader pedagogical generalizability. Likewise, the relationship between ICALL and human cognition remains insufficiently investigated. Ruiz Hernández [27] showed that ICALL can enhance learners' working memory, yet other cognitive abilities—such as creativity, reflective thinking, and problem-solving—have received far less attention. This narrow perspective risks framing ICALL primarily as a technical support tool rather than as a comprehensive educational framework. The limited presence of triple-node linkages connecting pedagogy, AI technologies, and cognitive outcomes further underscores the fragmentation that currently constrains the field's theoretical and practical development.

These findings point to the need for a more integrated and future-oriented research agenda. Future studies should develop instructional models that foreground human–AI collaboration, ensuring that ICALL promotes not only efficiency but also higher-order skills and learner autonomy [25][18][3][8]. Design-based research could investigate how ICALL scaffolds reasoning in writing, fosters intercultural awareness in speaking, or enhances reflective thinking in reading. Mixed-methods approaches would be well-suited to capture the complex dynamics of ICALL implementation in authentic classroom settings. Equally important, interdisciplinary collaboration among educators, cognitive scientists, and AI specialists is needed to co-create systems that balance technological sophistication with pedagogical integrity.

The implications extend well beyond academic research. For teachers, these results stress the importance of adopting ICALL in ways that stimulate cognitive engagement and responsibility, rather than allowing AI tools to supplant learners' essential mental processes [46][51][16]. For policymakers, the findings highlight the urgency of professional training and curriculum reform that combine technological proficiency with pedagogical insight [45][38][41]. For scholars, this study underscores the necessity of moving beyond isolated, tool-centric investigations toward cross-disciplinary, theory-

driven models of ICALL integration. Only by doing so can ICALL realize its full potential as a transformative approach to language education.

Several limitations should also be acknowledged. This study relied on a relatively narrow set of keywords ("ICALL" and "EFL") and searched only three major databases (Web of Science, Scopus, and Google Scholar), which may have excluded relevant regional or non-English language studies. Citation-based metrics also tend to favor well-established publications while underrepresenting newer, potentially groundbreaking research. Moreover, as this study is cross-sectional, it cannot fully capture the long-term impact of recent contributions. Future bibliometric research should therefore broaden search strategies, incorporate multilingual sources, and apply alternative measures of scholarly influence, such as altmetrics or network-based impact indicators [10][11][20].

Despite these limitations, this study provides one of the most comprehensive overviews of ICALL–EFL research to date. The findings indicate that the field's future will not depend solely on technological advances but rather on the ability of educators and researchers to embed AI within coherent instructional frameworks that simultaneously cultivate human intelligence. ICALL has the potential not only to accelerate language learning but also to stimulate creativity, critical thinking, reflective judgment, and problem-solving within digital contexts [1][51][8]. By shifting from a purely tool-centered paradigm toward a more human-centered vision, ICALL research can contribute to more sustainable, equitable, and meaningful language education for future generations.

CONCLUSION

Fundamental Finding : This study identifies a substantial rise in ICALL research within EFL contexts from 2014 to 2024, especially following the COVID-19 pandemic, centering on three domains—ICALL–Intelligence, ICALL–Language Education, and ICALL–Pedagogy. While the first two are well established, ICALL–Pedagogy remains underexplored, revealing a gap in linking technological innovation with instructional design and learner autonomy. **Implication :** The results highlight the need to shift from tool-centered outcomes toward pedagogy-oriented frameworks that embed human cognitive abilities such as creativity, critical thinking, problem-solving, and intercultural competence within AI-mediated environments. **Limitation :** The investigation is limited by its use of a single keyword pair ("ICALL" and "EFL") and reliance on three databases, which may have omitted relevant regional or interdisciplinary research, making the findings a foundational rather than exhaustive representation of ICALL scholarship. **Future Research :** Subsequent studies should develop and test human–AI collaborative instructional models that foster metacognition, higher-order thinking, and learner responsibility across diverse contexts. Employing design-based and mixed-method approaches while incorporating teacher and learner perspectives will ensure pedagogical depth and contextual relevance in future ICALL implementations.

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research.

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