A bibliometric analysis of smart voice assistants for EFL listening and speaking in elementary education

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Abstract

This study presents a bibliometric analysis of research on smart voice assistants (SVAs) used to support English as a Foreign Language (EFL) listening and speaking skills in elementary education. Using Publish or Perish and VOSviewer, an initial dataset of 500 publications was screened based on relevance, educational level, and content focus. After applying inclusion criteria, 29 documents published between 2019 and 2025 were retained for full analysis. The annual publication trend indicates minimal research activity prior to 2023, followed by a sharp increase in 2025, suggesting emerging academic interest in this technology. Citation analysis shows that highly cited studies predominantly adopt systematic review approaches rather than classroom-based experimentation. Term co-occurrence mapping revealed only three recurring keywords *(Alexa, systematic review,* and *student)* indicating limited conceptual convergence and an undeveloped research vocabulary. These findings suggest that research on SVAs in early EFL learning is still in its infancy and lacks theoretical coherence, established pedagogical models, and large-scale empirical validation. The study highlights critical gaps and identifies implications for researchers, educators, and technology developers. As conversational AI continues to advance, smart voice assistants hold potential to transform oral language learning experiences for young learners; however, sustained research efforts are needed to shape their pedagogical integration, ethical use, and long-term educational value.

Keywords: smart voice assistants, EFL, listening skills, speaking skills, elementary education.

Contribution to Literature: This study provides the first focused bibliometric mapping of smart voice assistant research for EFL listening and speaking in elementary education. It reveals publication trends, citation patterns, and limited thematic convergence, highlighting the field's early developmental stage and identifying gaps for future empirical and pedagogical research.

1. Introduction

The rapid advancement of artificial intelligence (AI) has reshaped educational innovation, particularly within language learning contexts where speech-based interaction is essential (Holmes et al., 2019). Among emerging applications, Smart Voice Assistants (SVAs), including devices and platforms such as Alexa, Google Assistant, and AI-powered conversational agents, have gained increasing visibility in educational research due to their ability to provide interactive communication, pronunciation feedback, and natural language support (Terzopoulos & Satratzemi, 2020; Tsourakas et al., 2021). These technologies are becoming especially relevant in English as a Foreign Language (EFL) contexts, where limited authentic exposure often restricts opportunities for oral communication and listening practice (Dizon, 2020).

Listening and speaking are two of the most challenging communicative skills for young EFL learners, as they require the development of phonological awareness, accurate pronunciation, fluency, and comprehension processing (Bailey, 2020). Traditional classroom-based instruction may not always provide the individualized feedback or repeated oral practice required to master these skills. In contrast, SVAs and intelligent speech-recognition systems offer real-time feedback, adaptive interaction, and gamified engagement, features that have been shown to support language development and learner confidence in early learning environments (Ghoneim & Elghotmy, 2021; Hamouda, 2020). The increased reliance on digital learning tools during and after the COVID-19 pandemic has further accelerated interest in speech-based AI learning applications for young learners (Chen et al., 2020).

Despite the growing body of empirical studies and conceptual work on AI-assisted language learning, research in this area remains fragmented. Previous reviews have highlighted rapid growth in AI in education but also emphasized persisting gaps between technological development and pedagogical theory (Ouyang & Jiao, 2021; Zhai et al., 2021). However, to date, no bibliometric analysis has systematically mapped scholarly output specifically related to Smart Voice Assistants for EFL listening and speaking in elementary education. As a result, there is limited understanding of publication trends, influential works, emerging themes, or future research directions in this rapidly developing field.

To address this gap, the present study conducts a comprehensive bibliometric analysis of academic literature on Smart Voice Assistants for EFL listening and speaking in elementary education. Through the analysis of publication patterns, citation impact, authorship networks, and thematic keyword clusters, this study seeks to provide a structured overview of the knowledge landscape and identify future pathways for research and pedagogical development in AI-supported early language learning.

Based on the gaps highlighted in the existing literature and the emerging role of smart voice assistants in early EFL learning, this study is guided by the following research questions: (1) How has research productivity evolved regarding Smart Voice Assistants for EFL listening and speaking in elementary education over time? (2) Which authors, publications, and sources have contributed most significantly to the development of this research domain? (3) What thematic patterns, conceptual clusters, and emerging trends can be identified through co-occurrence and network visualization analysis? (4) What potential research gaps and future directions emerge from the current knowledge landscape?

Together, these questions aim to provide a structured mapping of the intellectual development within the field and identify areas where further academic exploration is needed. To answer these questions, a bibliometric and scientific mapping approach was employed using data extracted from major scholarly databases and analyzed through VOSviewer and complementary analytical tools.

2. Literature Review

2.1. Digital Literacies in Language Education

Artificial Intelligence (AI) has increasingly influenced educational practices, particularly in language learning, where intelligent tools support personalized feedback and interactive learning experiences (Holmes et al., 2019; Chen et al., 2020). Among AI applications, Smart Voice Assistants (SVAs), such as Alexa and chatbot-based systems, have emerged as promising tools for developing listening and speaking competence due to their speech recognition capabilities and natural language interaction features (Terzopoulos & Satratzemi, 2020; Dizon, 2020).

In EFL contexts, especially at the elementary level, learners often lack authentic exposure to spoken English and interactive speaking opportunities (Mart, 2020; Riadil, 2020). Recent studies demonstrate that SVAs can help address these challenges by supporting pronunciation practice, fluency development, and repeated listening input in a low-pressure environment (Dizon & Tang, 2020; Shin, Kim, et al., 2021). For instance, Alqarni & Alhramelah (2025) found that a customized smart assistant significantly enhanced young learners' speaking accuracy and listening comprehension.

Despite growing evidence of effectiveness, research in this domain remains scattered, with variations in tools, methodology, and implementation contexts (Huang et al., 2023; Zhai et al., 2021). Prior reviews focus broadly on AI in education, but no bibliometric mapping specifically examines smart voice assistants for EFL listening and speaking in elementary education, leaving knowledge gaps regarding research evolution, influential scholars, methodological patterns, and emerging themes.

2.2. Previous Research

Existing empirical studies have explored the use of smart voice assistants and AI-supported speech technologies in English language learning, particularly focusing on speaking fluency, listening comprehension, autonomy, and learner engagement. While findings generally support the positive impact of these tools, especially in elementary and beginner contexts, research varies widely in scope, instructional models, AI platforms, and methodologies. The studies presented in Table 1 summarize key scholarly contributions related to the integration of voice-based AI in EFL listening and speaking development. These works collectively form the foundational evidence base for the current bibliometric study.

Table 1. Previous research on smart voice assistants in EFL listening and speaking.

No.	Title	Ref.
1	Designing a Smart Voice Assistant Based on Artificial Intelligence to Develop Listening and Speaking Skills in English for Elementary School Students	Alqarni & Alhramelah (2025)
2	Evaluating Intelligent Personal Assistants for L2 Listening and Speaking Development	Dizon (2020)
3	Intelligent Personal Assistants for Autonomous Second Language Learning: An Investigation of Alexa	Dizon & Tang (2020)
4	Exploring the Use of an Artificial Intelligence Chatbot as Second Language Conversation Partners	Shin, Kim, et al. (2021)

No.	Title	Ref.
5	Using an Artificial Intelligence-Based Program to Enhance Primary School Stage Pupils' Listening Skills	Ghoneim & Elghotmy (2021)

Across these studies, smart voice assistants have shown consistent benefits in improving listening and speaking proficiency in EFL contexts, particularly for young learners. However, variability in tools, instructional frameworks, and assessment measures reveals the absence of a unified research trajectory. This lack of consolidation underscores the need for a bibliometric analysis to map research trends, thematic patterns, and future research directions, justifying the contribution of the present study.

3. Research Method

3.1. Research Design

This study employed a bibliometric analysis approach to systematically examine the development, patterns, and thematic directions of research related to Smart Voice Assistants for EFL Listening and Speaking in Elementary Education. The dataset was retrieved using Publish or Perish, which extracted indexed records from Google Scholar based on predefined keywords aligned with the study's scope (e.g., *"smart voice assistant"*, *"Alexa"*, *"EFL listening and speaking"*, *"elementary learners"*, *"AI-based language learning"*). The initial search yielded 720 articles, which were screened using inclusion and exclusion criteria.

After title and abstract screening, 682 articles were excluded due to irrelevance (e.g., non-EFL studies, general AI in education, adult learner focus, non-voice-assistant AI tools), duplication, or incomplete metadata. The final dataset consisted of 38 articles, which were exported in CSV and RIS formats for further analysis. The bibliometric workflow integrated descriptive statistical review and visual network analysis using Microsoft Excel and VOSviewer, following recommended bibliometric protocols.

3.2. Data Sources

The primary source of data consisted of peer-reviewed journal articles indexed in Google Scholar. Only publications explicitly addressing the use of smart voice assistants, speech-based AI, or conversational agents in EFL learning at the elementary level were included. The refined dataset of 38 eligible articles forms the analytical corpus of this study. The dataset includes publication metadata such as author and institutional affiliations, publication year, publisher information, citation count, keywords, abstract text and indexed citation links. These records served as the basis for quantitative trend analysis and network visualization.

3.3. Procedure of Data Collection

Data collection proceeded through four structured stages: (1) Data Retrieval: Publish or Perish software was used to collect bibliographic data from Google Scholar using targeted keyword combinations. (2) Screening & Filtering: Duplicate entries were removed, followed by screening of titles and abstracts to ensure alignment with the research topic. Articles focusing on AI in general education, non-voice systems, or non-EFL contexts were excluded. (3) Dataset Preparation: The final dataset was exported to Microsoft Excel for preliminary statistical categorization (publication frequency, citation rates, authorship concentration). (4) Computational Mapping: RIS-formatted data were processed in VOSviewer to generate keyword co-occurrence maps, citation networks, and research clusters.

3.4. Data Analysis

The analysis combined descriptive statistics and computational bibliometric mapping. Microsoft Excel was used to compute annual publication frequency and citation metrics. VOSviewer facilitated advanced relational analysis, including keyword co-occurrence mapping, citation strength and impact visualization, cluster identification of thematic patterns, and network overlay and density visual analysis

These procedures provided both macro-level publication trends and micro-level thematic patterns, supporting the identification of research gaps and emerging directions within the field of smart voice assistant integration in EFL listening and speaking instruction for elementary learners

4. Results and Discussion

4.1. Smart Voice Assistants in EFL Listening and Speaking in Elementary Education (2019- 2025)

The bibliometric analysis revealed a distinct publication pattern demonstrating that research on smart voice assistants in EFL listening and speaking for elementary learners remains at an emergent stage. From the initial retrieval of 500 indexed documents, only 29 articles met the predefined inclusion criteria, while one was excluded due to incomplete metadata, resulting in 28 fully analyzable publications. The limited dataset is not a limitation but a meaningful indicator of the field's developmental stage, suggesting that this topic is still forming its academic identity and conceptual structure.

As illustrated in Figure 1, the annual publication trend shows no relevant studies in 2019 and 2020, indicating that the integration of smart voice assistants into young learners' EFL competence was not yet the focus of empirical inquiry. The first eligible article appeared in 2021, followed by another in 2022, signaling early experimental adoption. A gradual increase occurred in 2023 and 2024, each year contributing four publications. A notable surge emerged in 2025 with 19 published studies, marking the first significant acceleration in research attention.

The numerical distribution is presented in Table 2, which shows that 65.52% of the total publications were produced in 2025 alone. This sharp rise may reflect several contextual drivers: post-pandemic normalization of AI-enhanced learning tools, improved accessibility of voice-interactive systems (such as Alexa, Siri, and Google Assistant), and growing interest in automated oral feedback mechanisms for young language learners.

The emerging nature of the field also implies several gaps. For instance, despite increasing usage of voice AI in educational contexts globally, there remains limited theoretical grounding, sparse longitudinal evidence, and minimal cross-linguistic validation particularly involving elementary-level EFL learners. Therefore, the upward trend observed in Figure 1 suggests not only increased academic interest but also a developing research frontier, where foundational studies are beginning to shape future directions.
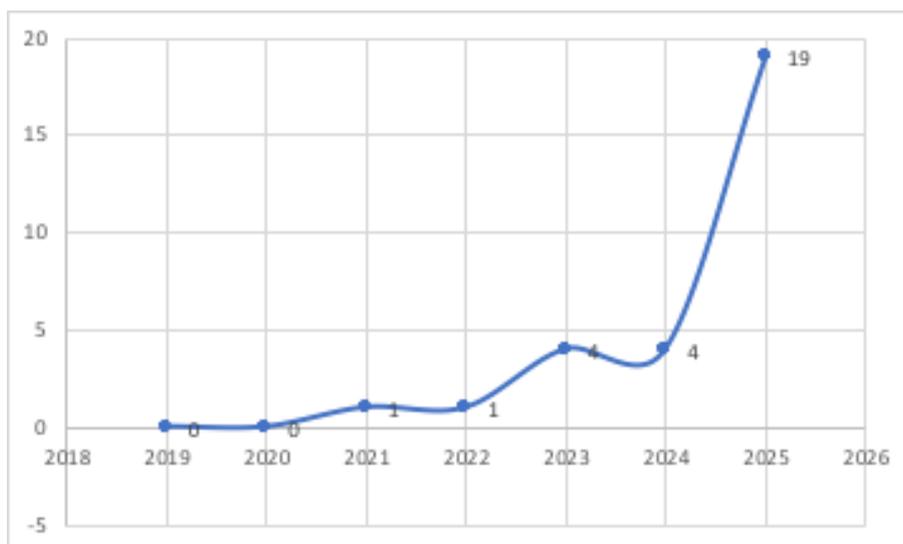
Figure 1. Annual report of publications by year (2019–2025).

Table 2. Annual publication distribution on "smart voice assistants in EFL listening and speaking in elementary education".

Year	Documents	Percentage (%)
2019	0	0.00
2020	0	0.00
2021	1	3.45
2022	1	3.45
2023	4	13.79
2024	4	13.79
2025	19	65.52
Total	**29**	**100%**

4.2. Most Influential and Highly Cited Publications

An analysis of citation patterns provides insight into the intellectual foundations and academic influence within the field. As shown in Table 3, citation counts vary widely, reflecting differences in publication year, research accessibility, and the visibility of the hosting journals. The most influential works are recent, aligning with the rapid growth of research output observed in 2024–2025. This suggests that the field is developing quickly and gaining scholarly momentum rather than relying on older foundational literature.

The highest-cited study by Ji et al. (2023) with 453 citations, focuses on conversational AI in language education, highlighting the intersection between automated interaction and human teacher collaboration. This indicates that early discourse in the field is not limited to technological affordances but extends to hybrid instructional roles, pedagogy, and instructional orchestration.

Similarly, Sharadgah & Sa'di (2022) and Katsarou et al. (2023) provide systematic reviews synthesizing AI-supported language learning, with 193 and 69 citations, respectively. These highly cited works suggest that systematic reviews have played a pivotal role in structuring the field and mapping instructional, technical, and methodological considerations, likely because the field requires conceptual scaffolding before extensive experimental validation.

Notably, experimental studies evaluating the effectiveness of voice-based AI on performance outcomes appear more frequently in 2024–2025, including works by Feng (2025) and Elmaadaway et al. (2025). The citation momentum of these early interventions indicates a shift from theoretical and review-based discussions toward empirical implementation, performance measurement, and learner affect studies such as anxiety and speaking confidence.

The presence of diverse platforms (e.g., voice chatbots, WhatsApp bots, and general AI assistants) further illustrates fragmentation in tool adoption, reinforcing the earlier finding that the field remains conceptually and technologically diverse. Yet, the concentration of citations among works focusing on listening, speaking, and fluency confirms that oral skill development remains the central instructional purpose of smart voice assistants at this stage of research.

Table 3. Most cited articles on smart voice assistants in EFL listening and speaking in elementary education.

No	Cites	Title	Year	Cites Per Year	Author(s)
1	453	A systematic review of conversational AI in language education: Focusing on the collaboration with human teachers	2023	226.50.00	Ji et al.
2	193	A systematic review of research on the use of artificial intelligence in English language teaching and learning (2015-2021): What are the current effects?	2022	64.33.00	Sharadgah & Sa'di
3	69	A systematic review of voice-based intelligent virtual agents in EFL education	2023	34.50.00	Katsarou et al.
4	64	Investigating the effects of artificial intelligence-assisted language learning strategies on cognitive load and learning outcomes: a comparative study	2025	64.00.00	Feng
5	41	The role of ChatGPT in English as a foreign language (EFL) learning and teaching: A systematic review	2024	41.00.00	Balcı
6	19	Evaluation of technological breakthrough in global education and future employment opportunity	2023	09.50	Ka
7	16	Boosting students' ESP vocabulary by utilizing AI chatbot	2024	16.00	Silitonga et al.
8	13	Development and application of AI chatbot for cabin crews	2021	03.25	Yang & Kim
9	11	Educators' Perception of Artificial Intelligence as Instructional Tool.	2024	11.00	Sadykova & Kayumova
10	10	Improving Primary School Students' Oral Reading Fluency Through Voice Chatbot-Based AI	2025	10.00	Elmaadaway et al.
11	8	A systematic review of the recent research on the usefulness of chatbots for language education	2025	08.00	Şahin Kızıl et al.
12	8	The effect of using Whatsapp bot on English vocabulary learning	2024	08.00	Al Algaithi et al.
13	7	The Effect of Artificial Intelligence (AI)-Mediated Speaking Assessment on Speaking Performance and Willingness	2025	07.00	Dakhil et al.

| No	Cites	Title	Year	Cites Per Year	Author(s)
		to Communicate of Iraqi EFL Learners			
14	7	Parent-led vs. AI-guided dialogic reading: Evidence from a randomized controlled trial in children's e-book context	2025	07.00	Xiao et al.
15	6	Facilitating pre-service teachers' instructional design and higher-order thinking with generative AI: an integrated approach with the peer assessment and concept map	2025	06.00	Liu et al.
16	5	Effects of GenAI interventions on student academic performance: A meta-analysis	2025	05.00	Gu & Yan
17	4	The Role of GenAI in EFL Speaking: Effects on Oral Proficiency, Anxiety and Risk-Taking	2025	04.00	Chen et al.
18	3	Eğitimde Yapay Zekâ ve Uygulamaları	2025	03.00	Kaçar & Avşaroğlu
19	2	"Fear of Missing out!": Veteran EFL Teachers' Perceptions of Using AI-Powered Tools in English Language Teaching	2025	02.00	Lap et al.
20	1	Chatting with Al Capone: Leveraging virtual conversational agents in emotional landscapes	2025	01.00	Sriganesh & Eamer
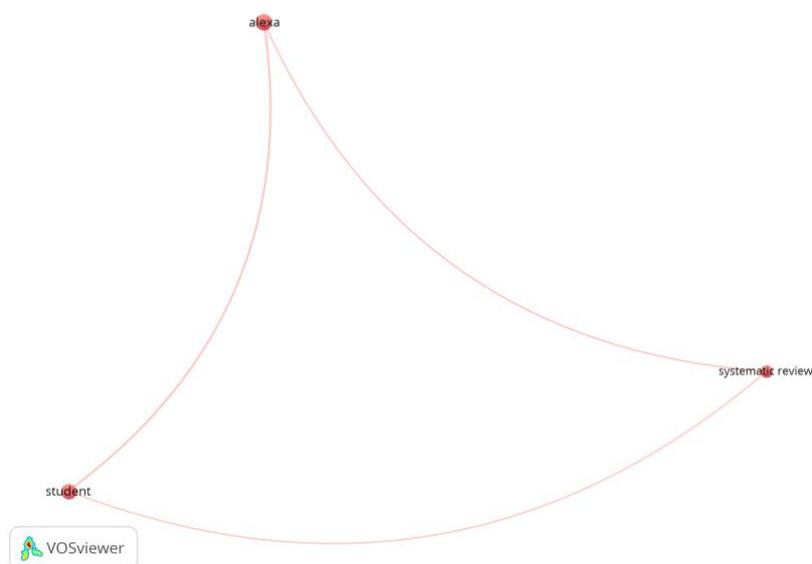
Figure 2. Network visualization based on co-occurrence of terms.

4.3. Visualization of Research Data Mapping of Smart Voice Assistants in EFL Listening and Speaking in Elementary Education

The bibliometric visualization generated using VOSviewer includes network, overlay, and density maps to illustrate the conceptual landscape of research on Smart Voice Assistants (SVAs) in EFL listening and speaking for elementary learners. As shown in Figure 2, the term co-occurrence analysis initially identified 223 extracted terms from

titles, abstracts, and author keywords. To ensure analytical precision and avoid noise in the mapping process, a minimum co-occurrence threshold of nine appearances per term was applied. This filtering process reduced the dataset to three qualifying terms: *Alexa*, *systematic review*, and *student*. To further refine the conceptual representation, only the top 60% most contextually meaningful and relevant terms were retained, resulting in the final set of three core terms used in the visualization.

The resulting network structure in Figure 2 shows that these three terms form a single, loosely connected conceptual cluster rather than multiple topic clusters typically expected in more mature research domains. The dominance of the term Alexa indicates that existing studies tend to focus on a specific Smart Voice Assistant rather than the broader technological category. Meanwhile, the presence of systematic review signals that current research is still heavily concentrated in secondary analysis stages, with fewer empirical classroom-based experimental implementations. The term student reflects the primary focus of the research (learners) aligning with the educational scope of this review.

The overlay visualization (Figure 3) offers temporal insight, confirming that meaningful published research activity did not emerge until 2024, consistent with the publication trend in Table 2. This suggests that the field is still in its infancy and has not yet accumulated a diverse body of research over multiple years.
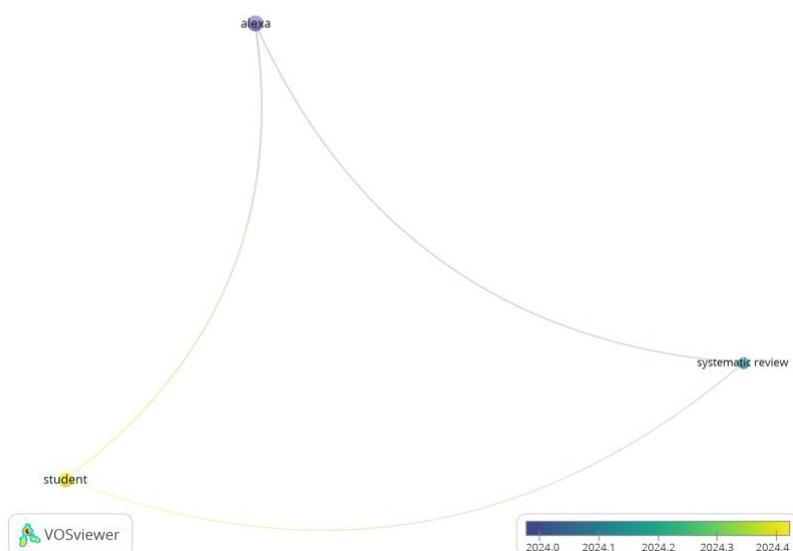

Figure 3. Overlay visualization based on co-occurrence of terms.

Finally, the density visualization **(Figure 4)** highlights a concentrated hotspot around the term Alexa, indicating its strong research presence. In contrast, the surrounding areas remain sparse, reflecting limited thematic expansion, methodological diversity, and domain-wide conceptual maturity.

Taken together, these visual patterns confirm that research on Smart Voice Assistants in EFL listening and speaking for elementary learners remains an emerging and underdeveloped field, characterized by narrow topical concentration, limited keyword diversity, and infancy-level academic structure. This reinforces the urgent need for empirical studies, diversified pedagogical approaches, and expanded terminology development within this domain.
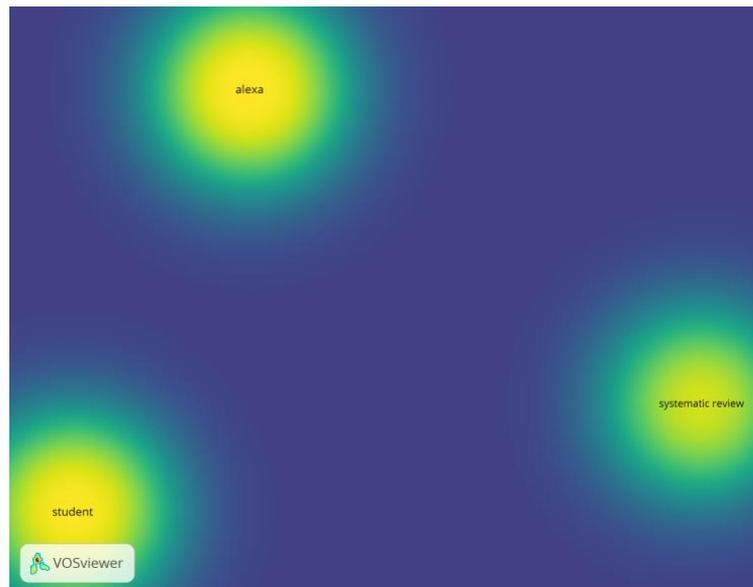
Figure 4. Density visualization based on the co-occurrence of terms

4.4. Synthesis and Implications

The bibliometric findings reveal a remarkably limited research landscape surrounding the use of smart voice assistants in supporting EFL listening and speaking skills at the elementary level. With only 29 documents meeting the inclusion criteria across a seven-year span, the dataset suggests that this field is still in its early developmental phase rather than an established research domain. This scarcity becomes even more evident in the keyword co-occurrence visualization, where only three terms ("Alexa," "student," and "systematic review") met the minimum threshold for relevance, indicating a fragmented discourse with weak conceptual convergence. Unlike bibliometric domains with established frameworks, this topic currently lacks shared theoretical foundations, methodological consistency, and discipline-wide terminology.

When compared with broader AI-enhanced language learning research, the current results appear consistent with emerging-technology adoption patterns: innovation first appears in controlled or experimental contexts before expanding into mainstream curriculum research (Ji et al., 2023; Sharadgah & Sa'di, 2022). Existing studies on conversational artificial intelligence in education (such as chatbots, intelligent tutoring systems, and virtual assistants) demonstrate clear pedagogical benefits, including increased motivation, improved pronunciation, and enhanced speaking fluency (Alqarni & Alhramelah, 2025; Katsarou et al., 2023). However, these technologies are predominantly implemented at secondary or tertiary levels, leaving early childhood and elementary education underrepresented. The limited number of studies may therefore reflect both technological accessibility constraints and pedagogical hesitation related to ethics, monitoring, classroom management, and teacher readiness.

Several possible factors may explain the minimal presence of smart voice assistant research at the elementary level. First, implementation at early ages involves unique concerns related to *privacy, safety, and parental consent*, which are stricter than at higher educational stages. Second, many elementary classrooms (particularly in non-English-dominant contexts) still struggle with basic digital infrastructure, making conversational AI integration logistically challenging. Third, teachers may lack both the technological competence and pedagogical confidence required to incorporate voice-interactive AI into structured learning sequences, particularly for language productive skills such as speaking. Finally, many smart assistants (e.g., Amazon Alexa, Google Assistant, Siri) are

not originally designed as pedagogical agents, requiring additional customization before they can serve as instructional tools.

Despite the current limitations, the findings carry important implications for future scholarship and practice. For researchers, the emerging but underdeveloped nature of the topic highlights numerous unexplored research opportunities, including longitudinal interventions, controlled experiments, classroom ethnographies, and design-based innovation research. For developers, the lack of pedagogically optimized smart assistants signals a need to move beyond generic command-response systems toward linguistically adaptive, curriculum-aligned voice interfaces built for young EFL learners. Meanwhile, policymakers and educators should consider developing structured guidelines to support the ethical and developmentally appropriate integration of AI-mediated tools in primary classrooms.

Looking forward, this field is likely to expand rapidly as conversational AI becomes more accessible, affordable, and context-aware. The current bibliometric patterns suggest that smart voice assistants are transitioning from emerging exploration toward early adoption. As foundational research grows and classroom-based evidence accumulates, smart voice assistants may evolve into a meaningful instructional support system for developing young learners' listening and speaking skills in English as a foreign language.

5. Conclusion

This bibliometric analysis provides an early mapping of the research landscape concerning the use of smart voice assistants in supporting EFL listening and speaking skills in elementary education. From an initial retrieval of 500 documents, only 29 met the inclusion criteria, indicating that this research area remains significantly underdeveloped. The limited volume of publications, particularly between 2019 and 2023, suggests that smart voice assistants have only recently begun gaining attention as a viable pedagogical tool for young language learners. This pattern is further reinforced by the keyword co-occurrence mapping, where only three meaningful terms met relevance thresholds, revealing a lack of shared vocabularies, frameworks, and dominant theoretical orientations.

Despite the scarcity of studies, the upward trend observed in 2024–2025 signals a growing scholarly interest aligned with global advancements in artificial intelligence and conversational learning technologies. Existing high-impact studies demonstrate promising pedagogical outcomes such as improved pronunciation, reduced speaking anxiety, enhanced learner engagement, and opportunities for personalized practice, particularly when smart assistants function as interactive and feedback-enabled speech partners. However, this evidence remains fragmented and is largely concentrated in systematic reviews rather than empirical field applications, highlighting the gap between technological potential and classroom reality.

Based on these findings, the study concludes that research on smart voice assistants in early EFL education is still in a formative stage, presenting extensive opportunities for future inquiry. Further research is needed to examine long-term classroom implementation, usability in diverse cultural contexts, ethical considerations, and the development of pedagogy-aligned voice assistant systems specifically designed for young learners. As AI technologies continue to evolve, smart voice assistants have the potential to become meaningful tools that support equitable access to oral language practice and personalized learning. However, realizing this potential will require collaboration among educators, technology designers, policymakers, and researchers to bridge the gap between emerging innovation and sustainable instructional practice.

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