

REVIEW

Artificial Intelligence in Language Teaching in the Context of Higher Vocational Education: A Bibliometric Mapping of Research Trends (2000–2024)

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ABSTRACT

The integration of artificial intelligence (AI) into language education has gained remarkable momentum over the past two decades. As researchers and educators explore how AI can transform teaching and learning practices, a growing body of literature has emerged to investigate its pedagogical, technological, and ethical implications. This study aims to provide a comprehensive bibliometric analysis of scholarly research on AI in language teaching from 2000 to 2024 in context of higher vocational education. Based on 475 peer-reviewed articles retrieved from the Scopus database, this research employs VOSviewer and Excel to map the intellectual landscape of the field. Key analyses include keyword co-occurrence, author collaboration networks, and temporal publication trends. The findings indicate a significant rise in research activity beginning in 2016, with dominant themes such as intelligent tutoring systems, natural language processing, AI-assisted writing tools, and ethical concerns in educational technology. This study not only identifies conceptual clusters and high-impact publications but also highlights gaps in empirical and longitudinal research. It offers valuable insights for scholars seeking to explore emerging directions in AI-assisted language education. For practitioners, the results emphasize the importance of pedagogical alignment, ethical AI use, and targeted teacher training. The paper concludes by suggesting future avenues for research that integrate interdisciplinary approaches and address the evolving challenges of AI implementation in language training for higher vocational education.

Keywords: Artificial Intelligence (AI); Bibliometric Analysis; Educational Technology; Language Teaching; VOSviewer

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1. Introduction

The integration of artificial intelligence (AI) into language education has driven a transformative shift in how languages are taught, learned, and assessed. Over the past two decades, the proliferation of intelligent systems—from natural language processing engines to generative AI models—has accelerated innovation in language pedagogy, influencing curriculum design, feedback mechanisms, and learner engagement^[1,2]. This transformation is particularly evident in English as a Foreign Language (EFL) contexts, where the scalability and adaptability of AI tools align with institutional needs and learner diversity^[3].

Despite growing enthusiasm, the implementation of AI in language education remains uneven and often lacks empirical grounding^[4]. While early efforts primarily focused on automation and efficiency, recent developments emphasize personalized learning, adaptive tutoring, and real-time communication assistance^[5,6]. These technological affordances, however, raise complex questions about pedagogical coherence, learner autonomy, and teacher agency^[7,8]. As AI capabilities grow increasingly sophisticated—particularly with the emergence of tools like ChatGPT and speech-based analytics—educators must contend with the dual challenge of embracing innovation while safeguarding instructional integrity^[9,10]. Emerging research has documented the transformative power of AI across diverse instructional domains, highlighting its potential to enhance adaptive learning, real-time assessment, and learner motivation^[11]. Similarly, Qiao and Zhao^[12] demonstrated that ChatGPT-based speaking practice improved learners' fluency and self-confidence in oral English tasks.

The current research landscape is fragmented, often dominated by case studies or exploratory interventions with limited theoretical framing^[13]. Although numerous studies celebrate the benefits of AI-enhanced tools, few offer systematic accounts of the field's evolution, thematic clustering, or methodological orientations^[14]. Moreover, ethical concerns—such as data privacy, algorithmic bias, and over-reliance on automated feedback—remain peripheral in much of the discourse^[15,16]. Given the rapid evolution of the field, it is essential to conduct a systematic bibliometric analysis to capture key trends, thematic hotspots, and research gaps^[17].

In response to this gap, the present study aims to conduct a comprehensive bibliometric analysis of AI in

language teaching between 2000 and 2024, drawing from peer-reviewed articles indexed in the Scopus database. By employing visualization and co-occurrence mapping techniques, there is a pressing need to conduct updated, data-driven mapping of this growing trends, with attention to key-word clusters, influential publications, and underexplored domains^[18]. In doing so, this research contributes both a structural overview and a reflective assessment of how the field has evolved in the wake of AI-driven transformation.

Based on the scope and objective of this bibliometric study, the following research questions will guide the analysis:

1. What are the key research trends in the field of artificial intelligence in language teaching from 2000 to 2024?
2. Which authors, journals, and institutions have contributed most prominently to this field?
3. What are the most frequently used keywords and co-occurrence patterns that define the thematic structure of the field?
4. What are the emerging subtopics and gaps that future studies could explore within AI-enhanced language education?

2. Literature Review

2.1. Overview of AI in Language Teaching

The integration of artificial intelligence (AI) into language education is rooted in the longer history of computer-assisted language learning (CALL), which emerged in the 1960s and 1970s with the advent of early mainframe computers. Early CALL systems, such as PLATO (Programmed Logic for Automatic Teaching Operations), provided learners with repetitive grammar and vocabulary drills, reflecting the behaviorist pedagogical theories dominant at the time^[19]. These initial attempts were limited in interactivity and failed to account for the complexities of communicative competence and learner variability.

The 1980s and 1990s witnessed a gradual shift toward communicative CALL, where the focus moved from form-based instruction to meaning-oriented interaction. This phase corresponded with the introduction of more sophisticated programs that allowed learners to engage in simulations, games, and multimedia-based interactions. However, these systems

still lacked true “intelligence”—they were pre-programmed, linear, and offered limited adaptation based on learner input^[20].

With the emergence of AI as a transformative technology in the 21st century, the boundaries between traditional CALL and intelligent language learning environments began to blur^[21]. Artificial intelligence introduced capabilities such as natural language processing (NLP), machine learning (ML), and speech recognition, enabling systems to analyze, interpret, and respond to human language in increasingly nuanced ways^[22,23]. These developments allowed AI tools to provide tailored feedback, support adaptive learning trajectories, and simulate realistic conversational partners.

One of the earliest successful applications of AI in education came through Intelligent Tutoring Systems (ITS), which were originally developed for mathematics and science but were soon adapted for second language learning. Though powerful, these systems were largely confined to structured tasks and required extensive domain-specific knowledge engineering^[24]. Xiao^[25] conducted an experimental study demonstrating that AI-powered tools improved students’ structural coherence and lexical accuracy in argumentative writing tasks.

The 2010s marked a new era for AI in language education, driven by the explosion of big data, mobile computing, and deep learning. Meanwhile, AI-based speaking tools such as those evaluated by Qiao and Zhao^[12] have been shown to foster increased oral fluency and confidence, largely due to their low-stakes, non-judgmental environment. These platforms collected vast quantities of user data to optimize language instruction, moving toward a more learner-centered and data-driven model^[26].

Concurrently, automated writing evaluation (AWE) systems such as ETS’s Criterion and Pearson’s WriteToLearn started gaining popularity in academic writing instruction. These systems used NLP techniques to provide instant feedback on grammar, coherence, and vocabulary use, which significantly reduced teachers’ grading burden while supporting learner autonomy^[27,28]. Despite their utility, critics pointed out their limited understanding of context, tone, and rhetorical structure, especially for advanced language users.

Most recently, the advent of large language models (LLMs) such as OpenAI’s GPT-3 and GPT-4 has introduced an unprecedented level of linguistic sophistication and flex-

ibility to AI-assisted language learning. Unlike previous systems that operated within closed domains, LLMs are trained on vast and diverse corpora, enabling them to engage in near-humanlike text generation, dialogic interaction, and contextual reasoning^[29]. This development signifies a paradigm shift from reactive to generative AI in language education.

However, scholars caution against viewing AI tools as pedagogical panaceas. As Levy and Stockwell^[30] argue, technological affordances must be carefully aligned with second language acquisition (SLA) theories to achieve meaningful learning outcomes. The “technological determinism” of early CALL has been replaced by a more nuanced understanding that successful integration of AI requires thoughtful instructional design, critical digital literacy, and alignment with communicative and sociocultural approaches to language learning^[31].

In summary, the historical evolution of AI in language teaching reflects both technological innovation and pedagogical adaptation. From behaviorist drills to generative conversational agents, AI tools have evolved in complexity, scope, and educational impact. Yet, their effectiveness continues to depend on the broader instructional context, the role of the teacher, and the learner’s agency in navigating intelligent environments.

2.2. Teacher’s Role and Pedagogical Adaption

The integration of AI in language education has prompted substantial reflection on teacher agency and instructional adaptation^[32]. While some scholars argue that AI can free educators from routine assessment tasks, others caution against the erosion of teacher judgment and contextual sensitivity^[7,9]. Empirical studies reveal varied perceptions among instructors, ranging from enthusiastic adoption to resistance rooted in ethical uncertainty and lack of training^[10,33].

Professional development and curriculum alignment emerge as key factors influencing successful AI integration. Research shows that when teachers are involved in the design or customization of AI tools, adoption rates and instructional effectiveness improve^[34,35]. These findings suggest that pedagogical frameworks must evolve to account for the hybrid nature of AI-mediated teaching—where human judgment and algorithmic input must coexist in a coherent learning

ecology^[36].

2.3. Research Challenges

While the integration of artificial intelligence (AI) into language education holds substantial promise, it also raises critical challenges that must be addressed to ensure equitable, ethical, and academically sound implementation^[37]. These challenges can be divided into three areas: ethical concerns, instructional design dilemmas, and methodological gaps in the current research situations.

2.3.1. Ethical Considerations in AI-Supported Language Education

A growing body of literature attentions against the uncritical adoption of AI tools in educational settings due to their clear algorithms, biased training data, and potential misuse. One major concern is data privacy. AI platforms often collect extensive learner data—textual input, voice recordings, behavioral logs—which may be stored or analyzed without explicit user consent, violating privacy norms and national data protection laws^[38].

Moreover, algorithmic bias is a persistent issue. Since LLMs and AI scoring systems are trained on large corpora that reflect real-world linguistic and social biases, their output can perpetuate stereotypes or marginalize non-dominant language varieties. For instance, NLP-based grammar correctors often flag non-standard dialects as “errors,” implicitly reinforcing monolingual norms^[39].

Academic integrity also comes under examination. With the rise of tools like ChatGPT, students may be tempted to submit AI-generated essays or use automated answers in assessment tasks. This not only challenges traditional notions of authorship but also raises pedagogical dilemmas about meaningful engagement with learning tasks^[37]. Educators and institutions must therefore rethink assessment design, emphasizing process, critical reflection, and originality over mere output.

2.3.2. Pedagogical Challenges and Teacher Readiness

The effectiveness of AI tools is largely contingent upon the teacher’s capacity to integrate them meaningfully into instructional practice. However, surveys indicate that many language educators lack sufficient AI literacy—defined as the ability to critically evaluate, implement, and mediate

AI technologies in the classroom^[40,41]. Teachers may either avoid AI altogether or use it in technologically driven, pedagogically shallow ways.

Furthermore, there is a risk of pedagogical deskilling, where over-reliance on AI for feedback, content generation, or classroom interaction may reduce teacher agency and professional judgment. This concern echoes earlier critiques of automated teaching systems and underscores the need for sustained professional development^[42].

Another challenge is the misalignment between AI capabilities and instructional goals. Many AI tools, particularly commercially developed ones, are designed for general audiences rather than tailored to specific learner profiles or curricular outcomes. As a result, educators must expend significant effort to adapt these tools to context-specific needs—an often-overlooked labor burden.

2.3.3. Research Gaps and Directions for Future Inquiry

Despite the spread of AI-related studies in language education, several methodological and conceptual gaps remain. First, there is a geographical skew in research outputs. Most empirical studies are conducted in technologically advanced, English-dominant contexts, leaving out diverse linguistic, cultural, and socioeconomic settings^[43]. This limits the generalizability of findings and excludes critical perspectives from the Global South.

Second, much of the current literature focuses on short-term effects—immediate learning gains, user satisfaction, or engagement metrics—while neglecting long-term outcomes such as language retention, transferability, or cognitive development^[44]. Longitudinal and mixed-methods studies are needed to capture the complex dynamics of AI-assisted learning over time.

Third, there is limited theorization of how AI interacts with second language acquisition (SLA) principles. While some studies map AI tools onto pedagogical frameworks like TPACK or SAMR, few articulate how AI mediates core SLA processes such as noticing, input enhancement, or interactional feedback^[45]. A more robust theoretical foundation is essential for evaluating the depth—not just the breadth—of AI’s educational impact.

Finally, scholars urge a shift from “tool-centered” to “learner-centered” research agendas^[21]. Instead of asking what AI can do, future studies should explore how learners

negotiate, resist, or appropriate AI tools in situated contexts. This sociocultural turn would illuminate the emotional, and identity-related dimensions of AI-mediated learning.

3. Methodology

3.1. Research Design

This study employs a bibliometric approach to investigate the research landscape of artificial intelligence (AI) in language teaching from 2000 to 2024. Bibliometric analysis has become a well-established method in educational research, offering quantitative insights into publication trends, thematic developments, and intellectual structures of scholarly fields^[23,46]. It is suitable for identifying research trends, influential authors, and emerging themes over time. In particular, it is suited to synthesize dispersed and rapidly growing areas of inquiry such as AI-enhanced language education, where traditional literature reviews may lack comprehensiveness or scalability^[47].

3.2. Sample and Data Collection

The data for this study were retrieved from the Scopus database, which is recognized for its broad coverage of

peer-reviewed academic publications in social sciences and applied linguistics. To improve the accuracy, keywords were normalized prior to processing. This involved standardizing case format (e.g., “AI” and “ai” unified as “AI”); removing generic or non-informative keywords (e.g., “article”, “education”). The search query combined keywords such as “language teaching,” “language training,” “AI,” “artificial intelligence,” using Boolean operators to maximize recall and precision. The keywords cleaning was performed manually in Excel before uploading the CSV into VOSviewer. The search was restricted to articles and review papers published between 2000 and 2024. This timeframe reflects the significant evolution of AI technologies and their increasing application in education during the last two decades^[1,5].

After exporting the initial dataset from the Scopus database, researchers conducted a systematic data cleaning process. Duplicate entries were identified and removed using Excel’s conditional formatting and manual verification. The final dataset included 475 documents, exported in CSV format with full bibliographic metadata. All records were screened for relevance to the intersection of AI and language education. Publications focusing solely on general education, unrelated AI applications, or non-linguistic domains were excluded. Details of the search strategy are showed in **Table 1**.

Table 1. Search Query in Scopus.

Element	Description
Database	Scopus
Time Span	2000–2024
Document Types	Article, Review
Language	English
Search Fields	Title, Abstract, Keywords
Search Date	June 30, 2025
Search Query	(“language teaching” OR “language training”) AND (“educational technology” OR “artificial intelligence”)
Number of Results	475 records

3.3. Analyzing of Data

Following data collection, a two-stage analytical procedure was adopted. First stage analysis was carried out to assess the distribution of publications over the selected 25-year span. Using Microsoft Excel, the dataset was organized by publication year to reveal the frequency of articles per year. The resulting distribution illustrated the increasing research momentum in this domain, particularly over the past decade, and provided empirical support for the field’s rapid expansion.

The second stage involved thematic mapping through keyword co-occurrence analysis. For this purpose, the data were processed using VOSviewer, a specialized software tool for bibliometric visualization. The parameters of the process is illustrated in **Table 2**. The analysis focused on author keywords and index keywords, both of which were extracted and normalized to ensure consistency. VOSviewer was then used to generate a two-dimensional cluster map of co-occurring terms, revealing dominant research themes and their interconnections. High-frequency terms such as “language learning,” “artificial intelligence,” “educational technology,” and

“chatGPT” emerged as central nodes, often grouped into thematic clusters reflecting pedagogical innovation, adaptive feedback, intelligent tutoring systems, and learner autonomy.

This network visualization is shown in the following figure, where node size corresponds to keyword frequency and edge strength indicates the level of co-occurrence between terms.

Table 2. VOSviewer Parameters For the keyword co-occurrence analysis.

Counting Method	Full counting was applied
Minimum Number of Occurrences of A Keyword	Set to 5
Network Type	Co-occurrence network using “author keywords”
Software Version	VOSviewer 1.6.19.

The analysis was conducted using two primary tools: Microsoft Excel and VOSviewer. Microsoft Excel was employed for preliminary data cleaning and the generation of publication trends over time. VOSviewer, a visualization software widely used in bibliometric research was applied to generate keyword co-occurrence networks, author collaboration maps, and citation analyses^[48]. These visualizations support the identification of thematic clusters and reveal the intellectual structure of the field. The unit of analysis varied by visualization type: for keyword co-occurrence, the “author keywords” and “index keywords” fields were used; for co-authorship analysis, the “authors” field; and for co-citation, the “cited references”.

While the methodological approach adopted in this study offers both breadth and depth, certain limitations must be acknowledged. The exclusive reliance on the Scopus database, although justified by its indexing scope, may result in the omission of relevant publications found in complementary databases such as Web of Science or ERIC. Moreover, bibliometric analysis is inherently limited by its dependence on metadata; it cannot account for the theoretical depth, empirical rigor, or pedagogical validity of the individual studies analyzed. The results therefore reflect patterns of publication and thematic emphasis rather than qualitative assessments of research impact.

Despite these constraints, the chosen methodology provides a framework for addressing the research objectives. By combining publication trend analysis with keyword network mapping, this study captures both the historical evolution and the conceptual structure of AI in language teaching. The methodological rigor, combined with visual analytics, contributes to a systematic understanding of how artificial intelligence is shaping language education scholarship in the contemporary academic landscape.

4. Findings/Results

This bibliometric analysis provides a multi-dimensional understanding of how artificial intelligence has been integrated into the domain of language teaching from 2000 to 2024. Based on 475 documents retrieved from the Scopus database and visualized using Excel and VOSviewer, the results are analyzed along four primary dimensions: sequential publication trends, keyword co-occurrence networks, keyword density, and journal and citation distributions.

4.1. Sequential Trends in Publications

The annual distribution of publications shows a steadily increase over the past two decades. From 2000 to 2015, research output on AI in language education remained relatively limited, with fewer than 10 articles published annually. However, beginning in 2016, and particularly after 2020, there was a marked surge in publications, aligning with the rise of deep learning, large language models (LLMs), and broader integration of AI into educational environments. The steep growth between 2021 and 2024 suggests that the academic community is responding rapidly to technological shifts, particularly with the emergence of generative AI tools such as ChatGPT. This growth trend is visualized in **Figure 1**, which clearly reflects the explosive growth of scholarly output in recent years.

The trend analysis reveals a sharp and accelerating increase in research output, particularly after 2020. This surge corresponds closely with the global rise of AI applications in education and the widespread adoption of generative AI tools such as ChatGPT. The explosive growth indicates not only improving academic interest but also the urgency to explore AI’s pedagogical implications.

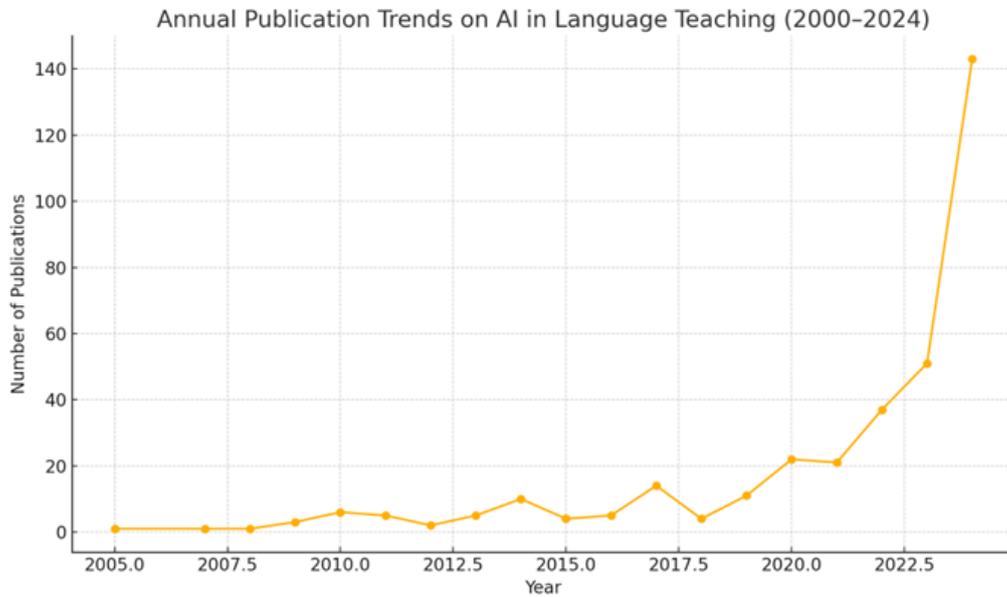


Figure 1. Annual publication trends on AI in language teaching (2000–2024).

4.2. Keyword Co-occurrence Analysis

To explore the thematic structure of the literature, a keyword co-occurrence network was generated using VOSviewer (Figure 2). This analysis revealed several high-frequency terms, including “artificial intelligence,” “language learning,” “educational technology,” “machine learn-

ing,” and “natural language processing.” The resulting network shows clear clustering of keywords into distinct themes. One cluster centers on technical implementation, while another focuses on pedagogical aspect. A third cluster emerges around generative tools and automation, including keywords like “ChatGPT,” “automated writing evaluation,” and “intelligent tutoring system.”

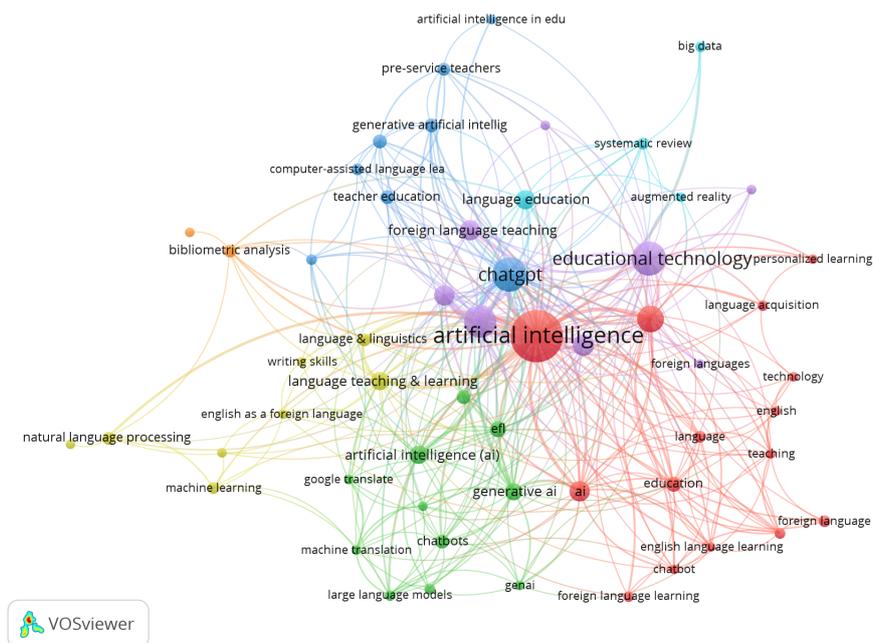


Figure 2. Keywords Co-occurrence.

These clusters indicate the interdisciplinary nature of the field, bridging linguistics, cognitive psychology, computer science, and educational technology. The prominence of new terms in the network—especially those appearing only after 2020—demonstrates the rapid evolution of scholarly interest and vocabulary.

4.3. Keyword Density Visualization

In addition to structural relationships, keyword density visualization offers insight into the intensity and spread of specific topics. Using VOSviewer’s density mode, **Figure 3** highlights high-frequency keywords with warmer colors (e.g., yellow), while less frequently mentioned terms appear in green and blue.

This visual clearly illustrates that “artificial intelli-

gence,” “language learning,” “educational technology,” and “ChatGPT” have become central to scholarly remarks. The clustering and density reflect hotspots of ongoing research and identify potential directions for future exploration, such as the ethical use of AI in education or personalized learning systems.

The co-occurrence and density analyses of keywords expose distinct thematic clusters within the literature. Core research areas include intelligent tutoring systems, automated assessment, machine translation, and natural language processing. At the same time, emerging terms such as “AI literacy,” “ChatGPT,” and “ethical concerns” suggest a shift toward more recent challenges and opportunities brought by large language models (LLMs) and generative AI in language learning contexts.

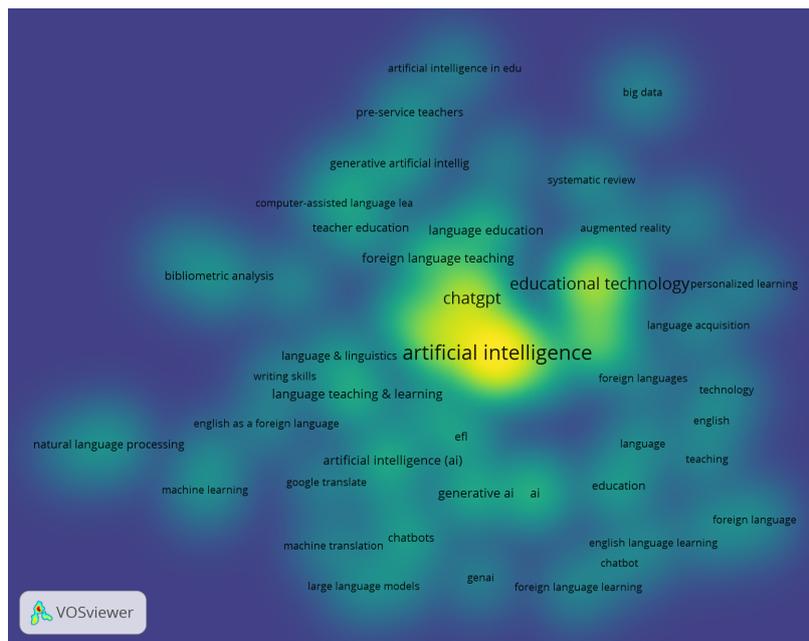


Figure 3. Keyword Density Map.

4.4. Journal Distribution and High-Impact Contributions

An analysis of the journals publishing the most documents on AI in language education reveals several prominent outlets. As shown in **Figure 4**, the top 10 journals include *Turkish Online Journal of Educational Technology*, *Applied Mathematics and Nonlinear Science*, *Forum for Linguistic studies*, *Education and Information Technologies*, and *World journal of English Language*, all of which demonstrate sustained engagement with technology-enhanced pedagogy.

The presence of multidisciplinary journals such as *Interactive Learning Environments* and *Educational Technology & Society* indicates that research in this field crosses traditional disciplinary boundaries. The distribution of publications across journals points to a conjunction between linguistics, education, and computer science. Leading journals in applied linguistics and technology-enhanced learning have increasingly become platforms for interdisciplinary studies. This trend reflects the blurring of disciplinary boundaries and the growing relevance of AI in shaping contemporary language pedagogy.

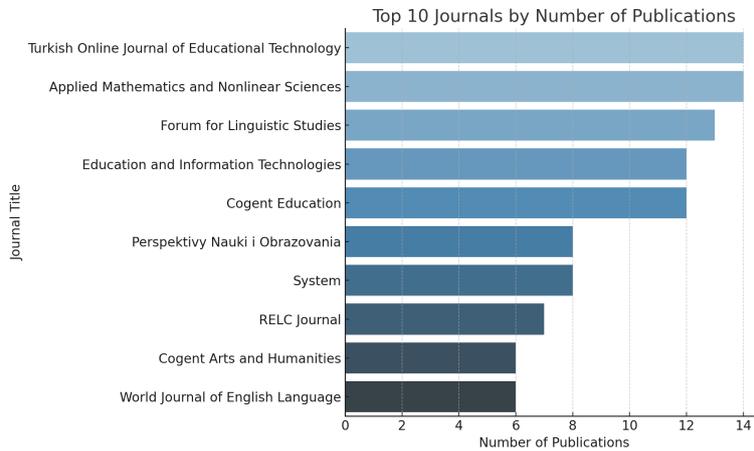


Figure 4. Top 10 Journals by Number of Publications.

Furthermore, **Table 3** lists the ten most cited articles in the dataset, emphasising key contributions that have significantly shaped the field. Notable entries include recent work

on ChatGPT and its implications for language education, as well as earlier studies on intelligent tutoring systems and language learning analytics.

Table 3. Top 10 Most Cited Documents.

Title	Authors	Year	Publication	Number
ChatGPT for Language Teaching and Learning	Kohnke et al. [49]	2023	RELC Journal	532
Technology and the future of language teaching	Kessler [50]	2018	Foreign Language Annals	287
Design of online intelligent English teaching platform based on artificial intelligence techniques	Sun et al. [51]	2021	Computational Intelligence	281
Exploring the possibility of using humanoid robots as instructional tools for teaching a second language in primary school	Chang et al. [52]	2010	Educational Technology and Society	266
Virtual reality in language learning: a systematic review and implications for research and practice	Parmaxi [53]	2023	Interactive Learning Environments	225
Employing humanoid robots for teaching english language in iranian junior high-schools	Alemi et al. [54]	2014	International Journal of Humanoid Robotics	149
Exploring generative artificial intelligence preparedness among university language instructors: A case study	Kohnke et al. [55]	2023	Computers and Education: Artificial Intelligence	136
The implementation of a flipped classroom in foreign language teaching	Basal [56]	2015	Turkish Online Journal of Distance Education	133
Neural machine translation in foreign language teaching and learning: a systematic review	Klimova et al. [57]	2023	Education and Information Technologies	119
A critical review of research on technological pedagogical and content knowledge (TPACK) in language teaching	Tseng et al. [58]	2022	Computer Assisted Language Learning	118

These influential publications not only reflect the historical development of the field but also point to shifting emphases—from early explorations of CALL and automation to contemporary debates on learner autonomy, AI feedback, and generative tools. The citation analysis highlights several influential publications that have guided the development of this field. These include both foundational works on computer-assisted language learning (CALL) and more recent studies

examining the role of AI in enhancing learner engagement, personalization, and feedback mechanisms. The presence of high-impact studies across diverse publication venues reinforces the idea that AI-driven language education is a globally recognized and rapidly evolving area of research. These findings establish a data-driven foundation for understanding not only the current issue of AI in language teaching but also the future directions in which the field is likely to develop.

4.5. Keyword Frequency and Thematic Distribution

To further explore the thematic focus of research on AI in language teaching, a keyword frequency analysis was conducted based on the metadata of the 475 selected articles. This analysis helps uncover the dominant research

directions and emerging interests within the field. As illustrated in **Figure 5**, the most frequently used keywords include artificial intelligence, ChatGPT, educational technology, language teaching, and English language teaching. These high-frequency terms reflect the dual emphasis on technological advancement and pedagogical innovation.

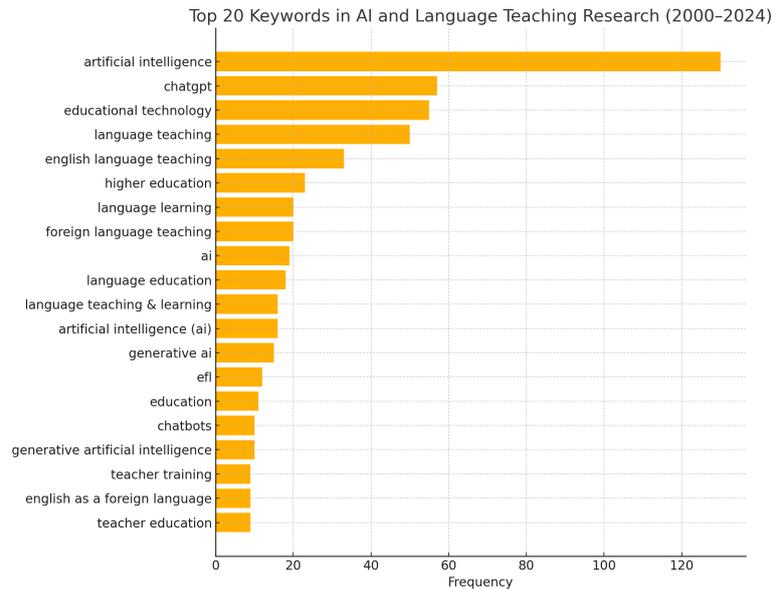


Figure 5. Top 20 keywords in publication (2000–2024).

5. Discussion

The findings of this bibliometric analysis reveal the evolving of artificial intelligence in language teaching over the past two decades. The discussion interprets the implications of the key results, connecting them to the theoretical frameworks and prior literature discussed earlier. By critically analyzing patterns in publication trends, keyword co-occurrence, author collaborations, and citation structures, this discussion seeks to reveal how the integration of AI has transformed pedagogical approaches and scholarly focus within the domain of language education. The discussion also explains the research questions raised in the introduction, examining how the observed trends consistent with or different from previous findings. It not only confirms the relevance of AI-driven methodologies in language teaching but also identifies underexplored areas that promote further investigation. This interpretive section aims to move beyond descriptive statistics, offering detailed insights into the significance of the results and their implications for both re-

searchers and educators. The discussion organizes four core areas: the acceleration of research publication, the impact of generative AI, interdisciplinary integration, underexplored ethical challenges.

5.1. Acceleration of Research Publication

The bibliometric results reveal a steady and notable rise in scholarly interest in the application of artificial intelligence (AI) in language teaching from 2000 to 2024, with a particularly sharp increase in publication volume after 2018. This trend is closely aligned with the global explosion in educational technology during the COVID-19 pandemic and the subsequent mainstreaming of AI-based tools. The rapid growth also suggests heightened acceptance of AI technologies within language education^[21], consistent with the Technology Acceptance Model (TAM), which suppose that perceived usefulness and ease of use significantly influence technology adoption among educators and institutions. While, post-2020 publications indicate a shift toward applied

research focused on implementation, learner outcomes, and institutional integration^[37]. This trend shows a transition from isolated innovation to system-level transformation.

5.2. The Impact of Generative AI

The introduction of generative AI, particularly large language models like ChatGPT, has significantly reoriented scholarly focus. As highlighted in the co-occurrence network and density visualization, terms such as “ChatGPT,” “automated feedback,” and “generative language tools” have risen sharply in frequency. This emergence has created a new research frontier concerned not only with AI’s functional capabilities but also with regarding accuracy, over-reliance, and content regulation^[59]. Hence, the educational value of generative AI depends not only on the technology itself but on how it is interpreted and implemented by users.

5.3. Interdisciplinary Integration and Journal Diversification

The analysis of journal publication reveals a clear trend of interdisciplinary. Traditional journals in applied linguistics and language pedagogy are now joined by technology-focused and cognitive science journals. A review of author contributions reveals a relatively dispersed yet collaborative situation. This trend supports the Adaptive Structuration Theory (AST), which holds that technologies are appropriated through dynamic interaction with institutional structures. In this case, AI tools are not simply adopted but are reshaping teaching methods^[35], professional development, and curriculum design. The increasingly interdisciplinary nature of AI-related language education research suggests the field is undergoing a process of structural transformation^[60].

5.4. Challenges in Ethics, Equity, and AI Literacy

Despite the enthusiasm around AI-enhanced instruction, ethical considerations remain underrepresented in the literature. Keyword analysis indicates that few studies explicitly address issues such as data privacy, digital equity, or the transparency of AI-generated content^[61]. This omission is concerning, particularly given the potential for AI tools to reinforce systemic inequities or mislead learners.

One pressing issue is algorithmic bias, which may re-

inforce stereotypes or inaccuracies in feedback, especially for learners from diverse linguistic and cultural^[19]. Moreover, unequal access to advanced AI systems—due to infrastructure disparities or digital literacy gaps—can further marginalize students in under-resourced settings. There is also growing concern over data privacy, as many AI tools require extensive user data to function effectively^[1]. These considerations highlight the need for transparent system design, inclusive datasets, and teacher mediation when integrating AI into language education. As the field advances, ethical guardrails and policy frameworks must be developed in parallel with technological innovation to ensure just and equitable outcomes for all learners.

6. Conclusions

This study conducted a comprehensive bibliometric analysis of research on artificial intelligence in language teaching between 2000 and 2024. Drawing upon data retrieved from the Scopus database and visualized through VOSviewer, the study aimed to reveal the research trends, and emerging themes in the field. Through keyword co-occurrence mapping, citation analysis, and author network visualization, the study addressed several key research questions related to the evolution of topics, influential contributions, and collaborative patterns.

The findings suggest that the application of AI in language education has experienced a significant increase in scholarly attention, particularly in the past five years. Notably, the emergence of large language models such as ChatGPT has aroused new discussions around real-time interaction, autonomous feedback, and generative learning. Keywords such as “educational technology,” “teacher training,” and “personalized learning” consistently appeared, pointing to a combination of pedagogical priorities and technological innovation. The results also show a gradual diversification of research interests, with scholars investigating the implications of AI across various instructional contexts, including higher education, K-12, and online learning environments.

Beyond its theoretical contributions, this study offers practical insights for educators, curriculum designers, and policymakers. The patterns identified in the literature can inform teacher training programs, particularly in preparing language instructors to integrate AI tools responsibly and

effectively^[62]. Moreover, understanding how AI has been conceptualized and applied over time may guide institutions in selecting appropriate technologies that cope with pedagogical goals rather than technological advertising.

Future research may benefit from bibliometric findings with qualitative analyses or case studies that explore AI use in real-world classrooms. Tracking of emerging keywords, such as “multimodal learning” or “ethics in AI,” may also produce important insights into the direction of educational research. As artificial intelligence continues to evolve, the interaction between language pedagogy and intelligent systems will remain a critical area of inquiry that demands interdisciplinary engagement and methodological innovation. Future research should explore how emerging multimodal AI systems—those integrating text, speech, and visual inputs—can enhance learners’ communicative competence and cognitive engagement in more authentic contexts. Recent advances in generative AI and speech recognition (e.g., multimodal large language models such as GPT-4o) offer unprecedented opportunities for real-time, adaptive, and emotionally responsive language tutoring^[2]. Moreover, immersive technologies like Augmented Reality (AR) and Virtual Reality (VR) have shown promise in facilitating situated language learning. Therefore, future studies should examine the long-term impacts of integrating multimodal AI and AR/VR platforms into formal language curricula.

6.1. Recommendations

This study underscores the evolving intersection between artificial intelligence and language teaching. For future researchers, longitudinal studies that examine the sustained impact of AI-powered tools on learner outcomes are crucial. In particular, experimental designs involving diverse learner populations and multilingual contexts could yield more generalizable insights. Furthermore, ethical considerations such as data privacy, algorithmic transparency, and teacher agency in AI-mediated classrooms guarantee deeper investigation.

For practitioners, this study highlights the need to critically evaluate AI tools not only for their technological innovation but for their pedagogical preparation. Educators are encouraged to integrate AI applications that enhance personalized learning, support formative assessment, and promote learner autonomy. Institutional managers should also arrange

teacher training to ensure that AI adoption is both informed and context-sensitive.

6.2. Limitations

While the present study offers a systematic and data-rich overview of AI-related research in language teaching, it is important to recognize its boundaries and the scope of its interpretation. The reliance on Scopus as the sole database, although justified by its academic consistency and attention, inevitably excludes relevant contributions from non-indexed journals, conference proceedings, or literature in non-English languages. One limitation of the present study lies in its exclusive reliance on the Scopus database, which, although comprehensive, does not include certain high-impact journals indexed in Web of Science, ERIC, or Google Scholar. As a result, some relevant works—particularly conference proceedings and emerging open-access publications—may not have been captured. Furthermore, our data extraction was limited to English-language publications, which potentially excludes valuable contributions from non-English-speaking regions. This linguistic filter may result in a Western-centric bias and underrepresent global perspectives on AI integration in language education. Future bibliometric reviews could adopt multi-database triangulation and include multilingual corpora to obtain a more diverse and inclusive picture of the field.

Moreover, the bibliometric methodology itself, though powerful in mapping structural patterns and publication trends, does not offer insights into the quality, pedagogical distinction, or learner impact of individual studies. Important questions regarding how AI tools are experienced by students, interpreted by teachers, or adapted to diverse classroom contexts remain beyond the reach of this approach. The absence of qualitative method means that many of the human-centered dynamics—such as emotional engagement, cultural negotiation, or ethical consideration—are not fully captured in the current analysis^[63], which should combine quantitative analysis with student surveys and thematic interviews.

To move the field forward, future research would benefit from approaches that complement bibliometric mapping with case studies, narrative reviews, or mixed-method investigations. A deeper exploration of teacher perspectives, student experiences, and institutional policies is essential

to understanding how AI is truly reshaping the language learning process. In addition, there is a growing need to investigate regional differences in AI adoption, to design pedagogical frameworks that account for sociocultural variation, and to ensure that technological development corresponds to sustainable language education goals. Their integration provides a comprehensive model for evaluating AI interventions in educational contexts^[63].

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Conflicts of Interest

The authors declare no conflict of interest.

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