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A Bibliometric Analysis of AI in Foreign Language Education (2015–2025)

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Abstract: This study employs a bibliometric approach and the VOSviewer software to conduct a visual analysis of research literature from the China National Knowledge Infrastructure (CNKI) database published over the past decade, focusing on artificial intelligence (AI) applications in foreign language education in China. By examining publication trends, journal distributions, and keyword co-occurrence networks, this research identifies major research hotspots and evolutionary pathways in the field. The findings reveal that the number of domestic publications in this area has entered a phase of rapid growth since 2022. The research hotspots are categorized into five main clusters: the integration of AI with college English teaching, new applications of generative AI, the intelligent transformation of education, personalized teaching in second language acquisition, and technology ethics and ecological construction. The evolutionary trend demonstrates a three-stage progression from "technology application" to "integrated innovation" and finally to "value and ethical reflection." Based on this analysis, the study anticipates that future developments will deepen along four dimensions: deeper technology integration, transformation of teacher roles, construction of academic integrity, and human-machine ethics governance, aiming to provide a reference for relevant research and practice.

Keywords: Artificial intelligence; Foreign language education; Bibliometrics; VOSviewer; Research hotspots; Evolutionary trends

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1. Introduction

Against the backdrop of digital technology reshaping the educational ecosystem and the wave of artificial intelligence, foreign language education is breaking through traditional boundaries, forming a "new foreign language" pattern [1]. From early computer-assisted language learning to current intelligent analysis based on big data and deep learning, technological iteration has not only innovated the form of foreign language teaching but also promoted its development towards precision, personalization, and intelligence [2]. In recent years, domestic academic circles have achieved fruitful research results on AI-empowered foreign language education, covering a wide range of research topics such as the construction of smart classrooms, the development of intelligent evaluation systems, the recommendation of personalized learning paths, and the transformation

of teacher roles [3]. However, with the rapid growth of literature quantity and the increasing diversification of research themes, there is an urgent need to adopt scientific and systematic research methods to conduct a macro-combing and summary of existing achievements. As an objective and visual research method, bibliometric analysis can effectively reveal the knowledge structure and development context of a discipline. Based on this, this study uses VOSviewer software to conduct a bibliometric analysis of domestic research literature on AI-empowered foreign language education from 2015 to 2025, aiming to sort out the research status, hot topics, and evolutionary trends in this field, and provide a reference for subsequent research and practice.

2. Data sources and research tools

The data for this study were sourced from the CNKI academic journal database. The search strategy was as follows: the time span was set from January 1, 2015, to June 30, 2025; journal sources were limited to CSSCI source journals and major foreign language core journals, as well as master's and doctoral dissertations; the search was conducted using the theme words "artificial intelligence" combined with "foreign language education" or "foreign language teaching" or "English teaching" or "second language acquisition." Based on the preliminary search, the titles, abstracts, and keywords of the literature were manually reviewed to exclude irrelevant, duplicate, and non-research publications, resulting in 496 valid Chinese documents.

This study used VOSviewer 1.6.20 for bibliometric analysis. The specific procedure was as follows: The exported bibliographic records (in RefWorks format) were first imported into the tool. In the "Type of analysis" module, "Co-occurrence" was selected, followed by "Keywords" in the "Unit of analysis" module, with the "Full counting" method confirmed. A minimum keyword frequency threshold was then set to 3, yielding 628 keywords. After removing duplicate records and standardizing the keywords, 386 core keywords were ultimately screened for final analysis. Finally, based on the correlation strength algorithm to calculate keyword co-occurrence strength, a modularity clustering algorithm with a resolution of 1.0 was enabled to identify hotspot clusters, generating a visualized keyword co-occurrence network map. In this map, nodes represent keywords, their size is proportional to the frequency of keyword occurrence; lines between nodes represent co-occurrence relationships, their thickness is proportional to the co-occurrence strength; node colors are assigned automatically by cluster analysis, with nodes of the same color belonging to the same research hotspot cluster.

3. Analysis of research status

3.1. Publication time and volume trend

Analysis of the annual publication volume (**Figure 1**) indicates that domestic research on AI-empowered foreign language education has experienced significant phased growth from 2015 to 2025. The first stage (2015–2018) can be regarded as a preliminary exploration period, with annual publication numbers remaining in the single digits. The research focus during this stage was on basic technological applications such as computer-assisted foreign language teaching, reflecting tentative characteristics of technological adoption. The second stage (2019–2021) saw a steady increase in publications, marking a period of steady development, with research themes expanding to deeper levels such as big data analysis and personalized learning. Since 2022, the field has entered a third stage of rapid growth, with an exponential increase in publication volume. This surge is primarily driven by the wave of generative AI technology, exemplified by ChatGPT, and national-level intelligent education strategic policies.

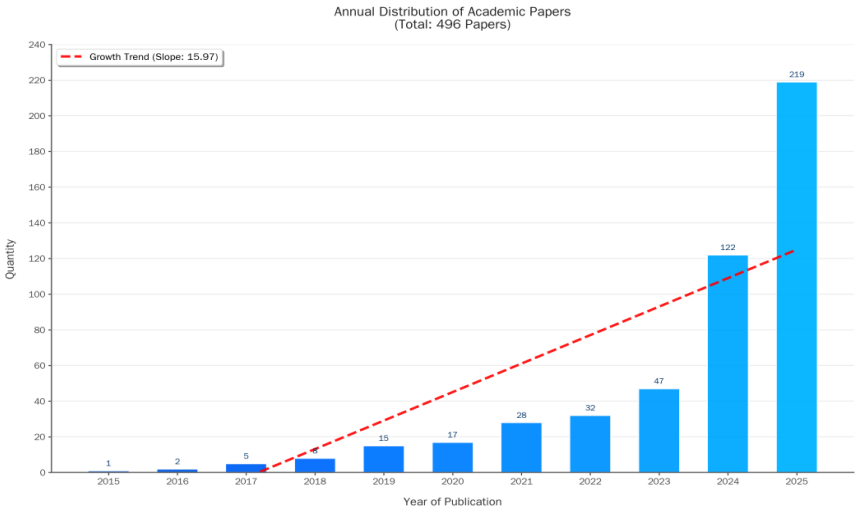

Figure 1. Annual distribution of publication volume of AI-empowered foreign language education

3.2. Regional and journal distribution of publications

In terms of regional distribution, research outputs show a high degree of spatial concentration, primarily located in economically and educationally developed regions such as Beijing, Jiangsu, Shanghai, and Guangdong. This reflects, to some extent, the regional imbalance in scientific research resources and academic output. High-yield institutions are mainly foreign language departments of normal universities and comprehensive universities, as well as units related to educational information technology, highlighting the interdisciplinary nature of this field. Regarding journal distribution, publications such as Foreign Language Teaching and Research in Electronic Technology, China Foreign Language, Foreign Language World, and Modern Educational Technology constitute the core platforms for disseminating findings in this area. The nature of these journals further confirms the interdisciplinary characteristics of research on AI-empowered foreign language education.

3.3. Analysis of research hotspots

This study employs keyword co-occurrence analysis to identify research hotspots, thereby revealing the core research directions and evolutionary trends. The keyword co-occurrence network map generated by VOSviewer (**Figure 2**) refines domestic research over the past decade into five core clusters, described as follows.

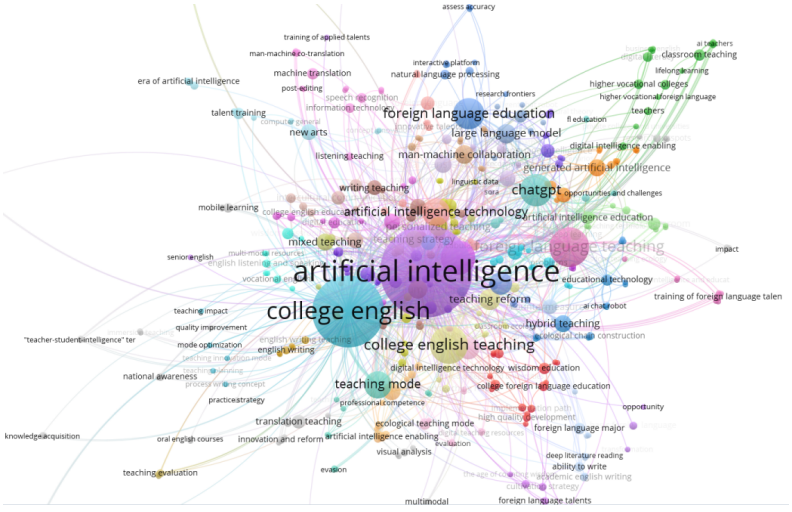

Figure 2. Keyword co-occurrence network map (Note: Node size = keyword frequency; Line thickness = co-occurrence strength; Color = cluster attribution)

3.3.1. Core cluster: In-depth connection between artificial intelligence and college English teaching

The deep integration of AI and college English teaching forms the core of the research network. In the map, the nodes for "artificial intelligence" and "college English" are the largest and most strongly connected, occupying a central hub position. Research in this cluster exhibits two distinct characteristics: first, the comprehensive coverage of teaching scenarios, from "listening teaching" and "writing teaching" to "speech recognition" and "machine translation," indicating that AI technology has been systematically embedded in teaching various foreign language skills; second, the continuous innovation of teaching models, reflected in derived keywords such as "blended teaching" and "immersion teaching," showcasing active exploration in using AI to build virtual classrooms, enable real-time interaction, and conduct data-driven teaching evaluation.

3.3.2. Hotspot cluster 1: New integration of generative artificial intelligence and foreign language education

Keywords such as "generative artificial intelligence," "ChatGPT," "generative AI," and "large language model" have smaller nodes but high link strength and are closely associated with high-frequency terms like "foreign language teaching" and "teaching strategy." They are also connected to terms like "opportunities and challenges" and "impact," collectively representing an emerging research hotspot over the past three years. Research in this cluster focuses on the opportunities and challenges of generative AI applications: opportunities include enhancing foreign language learning efficiency (e.g., translation assistance, scaffolding for academic writing); challenges center on issues such as "over-reliance," "skill degradation," and "academic integrity." Overall, this reflects close academic attention to the opportunities and ethical challenges posed by AI, signaling a shift in research focus from "tool use" to "relationship reconstruction."

3.3.3. Hotspot cluster 2: Intelligent and digital transformation of foreign language education

Centered on "digital intelligence enabling," "wisdom education," "teaching mode," and "digital transformation," this cluster focuses on how AI technology drives the transformation of new foreign language education paradigms [4] and maintains a medium-strength connection with the core cluster. Research here concentrates on two directions: first, the upgrading of teaching tools, from single speech evaluation tools to comprehensive system evaluations involving "multimodal resources + intelligent platforms" (e.g., building "foreign language smart classrooms"); second, the transformation of talent cultivation, with most studies focusing on constructing intelligent foreign language teaching environments at the university level and exploring new teaching models and talent development pathways adapted to them (corresponding to keywords "college English" and "training of foreign language talents").

3.3.4. Hotspot cluster 3: Personalized and precision teaching in second language acquisition

Centered on "personalized teaching" and "intelligent evaluation mechanism," and associated with second language acquisition theory keywords such as "output-oriented approach," this cluster represents a "technology adapting to educational laws" research focus. Node connections are dense, but scope is relatively concentrated, indicating high cohesion and specialization. Its core logic is "AI-based learner profile construction": by collecting student learning data, AI generates personalized learning paths (e.g., pushing grammar exercises to weaker students) and, combined with the output-oriented approach, realizes a closed-loop learning process of "input-output-feedback."

3.3.5. Hotspot cluster 4: Technology ethics and ecological construction of foreign language education

As a forward-looking cluster, technology ethics and ecological construction hold far-reaching significance, although the nodes are relatively scattered. Centered on "human-machine collaboration," "ecological teaching mode," and "ecological chain construction," and associated with keywords like "professional competence," the nodes are smaller and more dispersed. However, "human-machine collaboration," as a highly central node, bridges technology application and educational ethics, indicating a trend toward deeper research development. Research in this cluster focuses on how AI technology systematically reshapes the foreign language education ecology, covering two aspects: first, the construction of a teaching ecology, emphasizing a ternary collaborative mechanism of "teachers-students-AI" and clarifying that AI's role is that of an "assistant" rather than a "substitute"; second, the enhancement of foreign language teachers' "AI literacy" [1], emphasizing the need for teachers to master new skills such as "AI tool operation" and "learning data analysis."

3.4. Keyword co-occurrence analysis

The keyword co-occurrence network and cluster density further reveal the internal connections and evolutionary context of various research themes, characterized by the following three aspects:

First, the core research trajectory clearly shows a logical evolution from technological empowerment to a return to the fundamental goal of education. Three representative research paths have formed: (1) The "AI → college English → blended teaching" path constitutes a complete "technology carrier–application object–teaching mode" closed loop, representing the most mainstream research paradigm over the past decade; (2) The "ChatGPT → generative AI → human-machine collaboration" path highlights the impact of generative AI on traditional teaching structures, fostering a new paradigm centered on the ternary collaboration of "teachers-AI-students" [5]; (3) The "listening teaching → speech recognition → machine translation" path reflects the precise connection between specific technologies and specific language skill training, collectively building a technical support system for foreign language listening and speaking practice.

Second, the research evolution trend shows a three-stage progression from technology application, to integrated innovation and finally to value reflection. According to the temporal distribution of keywords, the research focus has undergone significant dynamic shifts. In the early stage (2015–2020), research was in a basic technology verification phase, with keywords like "mobile learning" and "machine translation" indicating the core task was to validate the feasibility of individual technologies in specific foreign language teaching contexts. In the middle stage (2021–2022), research entered an integrated innovation stage, with "blended teaching" and "personalized teaching" becoming high-frequency terms, marking a shift from "whether it can be applied" to "how to deeply integrate," and beginning to explore personalized paths and teaching model innovations based on learner profiles. In the recent stage (2023–2025), the field has entered a value reflection stage, with keywords like "ChatGPT" and "ethical issues" intensively emerging, indicating that while embracing technological innovation, academia is profoundly reflecting on associated ethical and social issues such as academic integrity, educational equity [6], and human-machine responsibility, reflecting a return from instrumental rationality to value rationality.

Third, the field exhibits clear interdisciplinary characteristics, with the integration of knowledge from multiple fields becoming an important enabling method. The high-frequency co-occurrence of keywords such as "information technology," "natural language processing," and "educational technology" strongly confirms this interdisciplinarity. Current research has transcended the single disciplinary boundary of foreign language education, deeply integrating theories and methods from computer science, linguistics, education, and data

science, and gradually forming a dynamic interdisciplinary research ecosystem integrating "technology development–teaching application–theoretical innovation."

4. Discussion and future prospects

Based on the above analysis of co-occurrence networks and evolutionary trends, combined with the evolution of AI technology and the direction of educational reform, this study proposes that the future development of AI-empowered foreign language education will focus on the following four key dimensions.

4.1. Deepening technology integration: From tool assistance to ecological reconstruction

Technology integration will continue to deepen, moving from isolated tool assistance to systematic ecological reconstruction. Current research has moved beyond the early stage of viewing AI as a single tool toward deep coupling with the entire teaching process. Future deepening will be reflected in two aspects: first, the integration of multimodal technology stacks, where large language models, natural language processing, speech recognition, and virtual reality technologies collaborate to build an immersive intelligent teaching environment integrating voice, text, images, and scenarios, thereby providing comprehensive support for language skills; second, the construction of a data-driven teaching closed loop, using learning analytics to convert student behavioral data from various intelligent platforms into intelligent feedback for optimizing teaching strategies and recommending personalized learning paths, ultimately promoting a fundamental transformation of the foreign language education ecosystem from traditional "experience-driven" to "data intelligence-driven."

4.2. Transformation of teacher development: From knowledge imparter to intelligent collaborator

Teachers are undergoing a profound transformation, evolving from knowledge imparters to collaborators and guides within the intelligent education ecosystem. In future scenarios where human-machine collaboration is the norm, the adaptation and upgrading of teacher roles are crucial. The responsibilities of foreign language teachers need to be reshaped from authoritative knowledge transmitters to designers of learning processes, guides for human-machine interaction, and facilitators of emotional value. To achieve this transformation, teacher development should focus on dual goals: first, systematically building teachers' AI literacy through establishing a hierarchical and classified training system, helping novice teachers master tool operations, and supporting senior teachers in developing AI-integrated teaching design and research capabilities; second, strengthening teachers' abilities in teaching diagnosis and intervention in the data age, enabling them to accurately interpret learning data provided by AI, optimize teaching decisions, implement personalized interventions, and appropriately address ethical conflicts brought by technology. Additionally, building cross-school and cross-regional teacher collaboration communities is crucial for sharing successful practices and bridging the gap between technology and teaching.

4.3. Construction of academic integrity: Building an academic norm system

The construction of an academic integrity system urgently needs strengthening to address the originality challenges posed by generative AI. In response to potential academic misconduct induced by generative AI in tasks like foreign language writing, a governance system integrating technical prevention, educational guidance, and assessment reform must be established. At the technical level, efforts should focus on developing more accurate AI-generated content detection tools and anti-cheating systems, and reasonably setting usage

permissions for AI tools. At the educational level, "AI literacy" and academic integrity education should be explicitly incorporated into curriculum goals, guiding students to understand and adhere to academic norms in human-machine collaboration. At the assessment level, evaluation system reform should be vigorously promoted, shifting the focus from final products to the learning process. By tracking students' cognitive development trajectories and effort levels, reliance on single-text outputs can be reduced, thereby mitigating the motivation for academic misconduct at its source.

4.4. Human-machine ethical governance: Building a human-machine symbiosis order

The establishment of a human-machine ethics governance framework is essential for the long-term, healthy, and orderly integration of technology into education. As AI plays an increasingly important role in teaching decisions, potential ethical issues such as algorithmic bias, data privacy, and responsibility attribution cannot be ignored. Future ethical governance should shift from the current "passive reflection" to "proactive construction." First, the auxiliary role of AI must be clarified in both concept and practice, ensuring that while it handles repetitive tasks, core educational aspects such as critical thinking guidance, cultural communication, and value shaping remain teacher-led, avoiding potential risks inherent in algorithms. Second, strict mechanisms for protecting teaching data privacy must be established, standardizing the collection, storage, and use of student behavioral data to prevent the leakage and misuse of personal information. Third, academia and industry must collaboratively explore and define clear boundaries for human-machine responsibility, determining how to allocate responsibility among teachers, students, and technology providers when problems arise in human-machine collaborative teaching. This requires in-depth theoretical construction and practical exploration from educational and ethical perspectives.

In summary, the future development of AI-empowered foreign language education will be a complex process involving the systematic integration of technology, ethics, and educational concepts. This requires researchers, practitioners, and policymakers to collaborate in building a sustainable educational ecosystem—based on deep technology integration, centered on teachers' professional development, rooted in academic integrity, and safeguarded by sound ethical mechanisms—ultimately realizing the intelligent educational vision of "technology as the carrier and educating people as the fundamental goal."

5. Conclusion

This study utilizes VOSviewer to conduct a bibliometric analysis of domestic research on AI-empowered foreign language education over the past decade. The results indicate that the field is in a period of rapid development and profound transformation, with its evolutionary trajectory showing a clear "three-stage progression" and research hotspots converging into five core clusters. Currently, the research perspective is expanding and deepening from the initial technical application level to in-depth dimensions such as teaching ethics, teacher development, and educational ecology. However, it must be recognized that current research still has notable deficiencies in empirical support, the depth of interdisciplinary integration, the construction of ethical norms, and the improvement of teachers' AI literacy, constituting shortcomings that need to be addressed in current research and practice.

Looking ahead, the future development of AI-empowered foreign language education should not stop at the iteration of "technical tools" but must firmly move toward "ecological synergy." This requires deepening intelligent support for the entire teaching process with multimodal technology, consolidating the practical

foundation through the systematic transformation of teacher capabilities, safeguarding the academic essence of education with a robust academic integrity system, and clarifying the responsibility boundaries of human-machine collaboration with well-defined ethical norms. Only through such systematic changes can the fundamental goal of "technology serving the essence of education" be truly achieved, thereby promoting the transformation of foreign language education from traditional standardized training toward a more personalized, high-quality, and equitable direction, providing solid support for foreign language talent cultivation and the digital education strategy in the new era. Subsequent research can further focus on the empirical effectiveness of human-machine collaborative teaching, the development of intelligent teaching resources for less commonly taught languages, the deepening of interdisciplinary cooperation, and the introduction of Sino-foreign comparative perspectives, thereby continuously enriching the theoretical and practical connotations of this field and ultimately promoting the healthy and sustainable development of foreign language education in the intelligent age.

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Disclosure statement

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