

A Review on the Foreign Language Teaching Empowered by Artificial Intelligence in Recent Ten Years: A Scientometric Analysis Based on CiteSpace

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Abstract

This paper employs CiteSpace 6.2.R6 to conduct a visualization analysis of re-researches on foreign language teaching empowered by artificial intelligence from the China National Knowledge Infrastructure (CNKI) database and Web of Science (WOS) core collection database between 2014 and 2024. It aims to explore the characteristics of researches on foreign language teaching empowered by artificial intelligence. The present study yielded the following major findings: both domestically and internationally, there is a shared interest in exploring how artificial intelligence (AI) can enhance the efficiency and personalization of foreign language teaching. However, the domestic researches predominantly put emphasis on the optimization of existing pedagogical models through data analysis and intelligent tutoring systems, highlighting the direct application of technology in enhancing educational quality. Conversely, foreign researches tend to investigate the role of artificial intelligence in fostering interactive and immersive learning experiences, with a particular focus on technological innovation and cross-cultural adaptability.

Keywords

Artificial intelligence; Foreign language teaching; Citespace; AI

1. Introduction

In recent years, the rapid development and widespread adoption of artificial intelligence (AI) technology have increasingly made it a focal point in educational research. Particularly in the field of foreign language teaching, the integration of AI has introduced numerous innovations and possibilities for teaching practices. This paper aims to conduct a comprehensive review of research over the past decade on how AI enhances foreign language teaching. CiteSpace is used for scientometric

analysis and it explores the evolution of research areas and shifts in research hotspots. 118 Chinese journal articles was collected from the China National Knowledge Infrastructure (CNKI) database. 117 journal articles was collected from the WOS core collection database. Then, this paper categorizes and summarizes these research findings to reveal the latest advancements in AI technology to improve the quality and efficiency of foreign language instruction, providing valuable insights for future research in this area.

2. Research Design

2.1. Research method

This paper mainly adopts the bibliometric method and uses CiteSpace 6.2.R6 for visual analysis to show the core hotspots, development history and overall knowledge structure of this research field. CiteSpace is a visual knowledge graph analysis tool based on the principle analysis of scientometrics. It can extract keywords, authors, institutions and other information from a large number of academic references to generate knowledge graphs and reveal the hot spots, trends, evolution and other characteristics of the research field. It is a new tool widely used in the field of scientometrics at present. .

2.2. Data Acquisition and Retrieval Strategy

In order to ensure the credibility and exploration value of the sample data source, this study selected CNKI database and WOS core collection database as the search database. The subject search terms of domestic reference retrieval are: artificial intelligence AND foreign language teaching, the retrieved reference span from 2014 to 2024, the retrieval time is on July 15, 2024. 118 records were obtained after manual screening. In the core collection database of Web of Science, in order to ensure the comprehensive and accurate sample data, after several retrieval experiments, the final search terms were set as "artificial intelligence* English teaching" and "artificial intelligence* foreign language teaching". The obtained reference spans from 2014 to 2024, and the retrieval time is on July 15, 2024. The restricted reference types is Article , and 117 papers are obtained after screening.

3. The number of annual publication volumes analysis

In recent years, the rapid advancement of artificial intelligence technology has led to its increasingly widespread application across various domains, including education. In particular, the integration of AI into foreign language instruction has brought about profound transformations in traditional teaching methodologies, fostering innovation in pedagogical approaches and enhancing learning outcomes. Consequently, there has been a growing scholarly interest in exploring the role of artificial intelligence in foreign language education, as evidenced by a notable increase in the number of related academic publications.

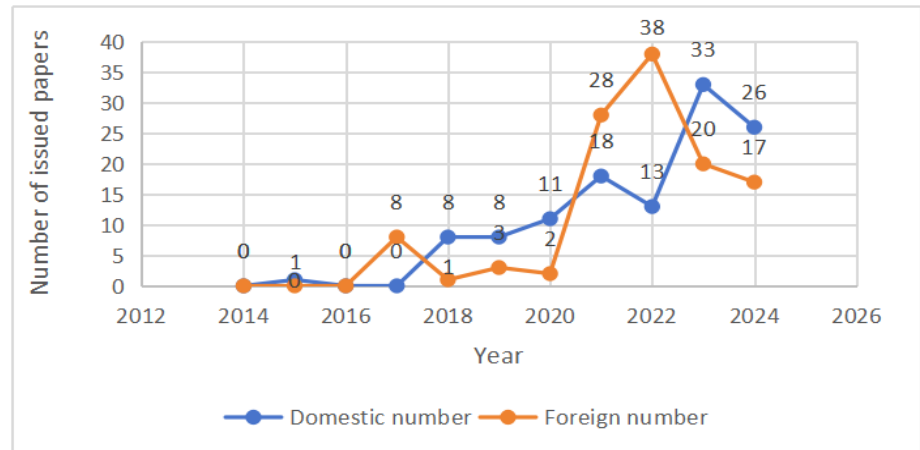


Figure 1. Annual publication volumes (figure caption).

Figure 1 indicates that the volume of research papers on AI-enhanced foreign language teaching has experienced substantial changes over the past decade. Based on the figure, the studies on foreign language teaching empowered by artificial intelligence can be roughly divided into three stages: the early exploration stage (2014-2017), the steady growth stage (2018-2021), and the rapid expansion stage (2022-2024). During the early exploration stage (2014-2017), the number of average annual publications is scarce, showing the fact that artificial intelligence had not yet fully entered the public view at that time. Therefore, there were few articles about foreign language teaching empowered by artificial intelligence. In the steady growth stage (2018-2021), the number of publications is 45, signifying progress compared to the exploratory development stage, and indicating a burgeoning interest in academic circles in the researches on foreign language teaching empowered by artificial intelligence. From 2022 to 2024, the publications in this research field reveals a notable increase followed by a slight decline. Specifically, the number stood at 13 In 2022, indicating a relatively low level of scholarly attention and engagement with the topic. Moving to 2023, there was a significant jump in the number of publications, rising to 33. The surge in publications could be attributed to the growing recognition of AI's potential to revolutionize teaching methodologies, personalize learning experiences, and improve student outcomes in foreign language learning. However, in 2024, the number of publications decreased slightly to 26. While this decline may appear concerning at first glance, it does not necessarily signify a waning interest in the field. Rather, it could reflect a shift in focus or consolidation of research efforts. As the field matures, researchers may be transitioning from exploratory studies to more in-depth investigations, targeted interventions, or evaluations of the effectiveness of AI-based teaching approaches.

From 2014 to 2024, the trend in the number of publications on AI-powered foreign language teaching shows a significant increase. From 2014 to 2016, the number of

publications was zero, indicating that artificial intelligence in foreign language education had not yet garnered substantial attention during this period. In 2017, the number of publications rose abruptly to 8. Between 2018 and 2019, the number of publications fluctuated slightly, with 1 and 3 publications, respectively. This period may have been influenced by technological advancements and initial policy guidance but remained exploratory in nature. In 2020, the impact of the COVID-19 pandemic accelerated the digital transformation in education, bringing AI applications in remote teaching into focus, and the number of publications increased to 2. In 2021 and 2022, there was a substantial rise in publications, reaching 28 and 38, respectively. This growth is closely associated with the maturation of AI technologies and their expanding application in education. Additionally, the introduction of supportive policies for AI in education by various countries and regions contributed to the increased research output. In 2023 and 2024, the number of publications slightly decreased to 20 and 17, respectively. This decline may indicate a stabilization of initial research enthusiasm. As the technology becomes more widespread, research has entered a more mature and systematic phase.

4. A Comparative Analysis of the Research Hotspots of Foreign Language Teaching Empowered by Artificial Intelligence at Home and Abroad

A comparative analysis of research hotspots in foreign language teaching empowered by artificial intelligence, both domestically and internationally, can elucidate the focal points and evolving trends within this domain across various regions.

4.1. Statistical Analysis of High-frequency Keywords at Home

The top 10 keywords in China are: artificial intelligence(50), foreign language teaching(33), foreign language education(9), foreign language teacher(6), information literacy(5), big data (4), foreign language(4), educational reform (3), foreign language discipline(3), and college English(3). Compared with the equivalent words of "foreign language", "artificial intelligence" and "foreign language teaching" are strong keywords, appearing 50 times and 33 times. From Table 1, "foreign language teaching" and "artificial intelligence" have become key nodes in domestic research fields, indicating that domestic research focuses on how to utilize AI technology to enhance teaching efficiency, personalize learning experiences, assess language skills, and improve cross-cultural communication abilities.

Table 1. The Statistical Results of High Frequency Keywords at Home (Top 10)

Serial Number	Frequency	Centrality	Year of First Appearance	Keywords
1	50	1.01	2018	Artificial intelligence
2	33	0.55	2018	Foreign language teaching
3	9	0.2	2021	Foreign language education

4	6	0.07	2018	Foreign language teacher
5	5	0.06	2021	Information literacy
6	4	0.01	2020	Big data
7	4	0.05	2015	Foreign language
8	3	0.02	2021	Educational reform
9	3	0.01	2023	Foreign language discipline

4.2. Statistical Analysis of High-frequency Keywords Abroad

From Table 2, the keywords such as artificial intelligence, English teaching, big data, behavior, machine learning, model, algorithm and college English are the hot re-search directions abroad. Over the past decade, international interest in AI's role in foreign language teaching has largely centered on leveraging AI, big data, and machine learning to boost teaching personalization and efficiency, advance educational philosophies, and innovate teaching methods. From the year when keywords first appeared, keywords such as machine learning (2021) and algorithm (2021) appear late.

Comparing the research hotspots at home and abroad, we can find that although both focus on improving the efficiency and personalization of foreign language teaching, there are some differences in specific applications and technical directions. Domestic research focuses more on how to optimize the existing teaching model through data analysis and intelligent tutoring systems, emphasizing the direct application of technology in improving teaching quality; while international research tends to explore the application of artificial intelligence in creating interactive and immersive learning experiences, focusing on technological innovation and cross-cultural adaptability. These differences reflect the different strategies and re-search focuses of various regions in using artificial intelligence technology to improve foreign language teaching.

Table 2. The Statistical Results of High Frequency Keywords abroad (Top 10)

Serial Number	Frequency	Centrality	Year of First Appearance	Keywords
1	56	0.47	2017	artificial intelligence
2	7	0.24	2017	English teaching
3	6	0.27	2019	big data
4	6	0.1	2021	machine learning
5	6	0.19	2020	model
6	4	0.08	2021	algorithm
7	4	0.05	2017	college English
8	4	0.25	2017	design
9	4	0.34	2017	education
10	4	0.11	2022	English

5. Cluster Analysis of High-frequency Keywords at Home and Abroad

Cluster analysis of high-frequency keywords in both domestic and international contexts reveals significant patterns and trends in the field of artificial intelligence in foreign language teaching. This analysis helps to identify the key areas of focus and emerging themes in research and practice.

5.1. Domestic Keyword Cluster Analysis

In order to further understand whether domestic research hotspots have commonalities, cluster analysis is carried out on keywords according to the "LLR" algorithm. The module value of this graph is 0.6455, which is between 0 and 1, indicating that the module structure is reasonable. The average contour value is 0.9227, which is greater than 0.7, indicating that the cluster results are convincing. The Atlas shows 9 cluster categories: #0 foreign language teaching, #1 artificial intelligence, #2 path, #3 foreign language teacher, #4 foreign language, #5 intelligentization, #6 information literacy, #7 machine translation #8 effect.

Through qualitative analysis of each cluster and the keywords included, domestic research focuses are divided into three categories: application of artificial intelligence in foreign language teaching, artificial intelligence and the development of foreign language teachers, and effectiveness of artificial intelligence in empowering foreign language teaching, as shown in Table 3.

Table 3. The cluster analysis of keywords of foreign language teaching empowered by artificial intelligence at home

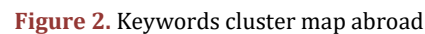
Cluster Serial Number	Cluster name	Key research fields
#1 #5 #7	Artificial intelligence Intelligentization Machine translation	Application of artificial intelligence in foreign language teaching
#3 #6 #8	Foreign language teacher Information literacy Effect	Artificial intelligence and the development of foreign language teachers
#0 #2 #4	Foreign language teaching Path Foreign language	Effectiveness of artificial intelligence in empowering foreign language teaching

The first category is the application of artificial intelligence in foreign language teaching, which mainly includes three clusters: #1 artificial intelligence, #5 intelligentization and # 7 machine translation. It highlights technology integration and teaching innovation, personalized learning path design, language skills assessment and feedback. Kong Yonghong and Yang Ping (2024) contends the advancement of artificial intelligence in the fields of speech, image, and text can effectively improve foreign language learners' basic skills in listening, speaking, reading, and writing, and help the development of foreign language teaching. Chen Jianlin (2020) explored the relationship between artificial intelligence and foreign language teaching, pointing out that the application of artificial intelligence technology is an inevitable trend in the process of educational informatization.

The second category is the artificial intelligence and the development of foreign language teachers, which mainly includes three clusters: #3 foreign language teacher, #6 information literacy and #8 effect. When it comes to the professional devel-

The third category is the effectiveness of artificial intelligence in empowering foreign language teaching, including 3 clusters of #0 foreign language teaching, #2 path and #4 foreign language. It focuses on the transformation and innovation in teaching models. Yang Gang and Gu Shimin (2023) approach the issue from the perspective of risks and mitigation, summarizing the potential risks associated with the transformation of foreign language teaching models due to artificial intelligence. Xu Ling et al. (2024) explore how to achieve digital empowerment in foreign language teaching by examining technological characteristics, resources, and issues. Their aim is to provide references for cultivating diverse foreign language talents, improving teacher competencies, and enhancing teaching quality, as well as offering theoretical and methodological guidance for constructing a new ecosystem of digital-integrated foreign language education.

The foreign keyword clustering map is shown in Figure 3, and 9 cluster groups are obtained. They are #0 chatgpt, #1data mining, #2 efl, #3 automation, #4 system development, #5 business english, #6 machine learning, #7 attitudes and #8 reflective thinking.



Each cluster and the keywords included were analyzed, and the foreign research focus was divided into three categories: application of artificial intelligence technology, AI-Assisted teaching content and methods, cognition and reflection facilitated by AI. After integrating the clustering results in Figure 2, Table 4 was obtained.

6. Foreign Keyword Cluster Analysis

The analysis examines the evolution of research on AI-empowered foreign language teaching both domestically and internationally. It delves into key milestones, methodologies, and advancements in AI applications within language education.

6.1. Analysis of the Research Process of Foreign Language Teaching Empowered by Artificial Intelligence at Home

Early Exploration (2014-2015): During this phase, the application of artificial intelligence in foreign language education was still in its formative stages. The volume of related research publications was relatively sparse, with certain years (e.g., 2014, 2016, and 2017) seeing no published papers in this domain. This suggests that at that time, there was a lack of widespread consensus among researchers and educators regarding the value and potential of AI in foreign language instruction.

Steady Growth (2016-2020): Starting in 2018, as AI technology continued to advance and its application cases in foreign language education began to accumulate, the number of relevant research publications began to increase steadily. Especially after the release of the "China New Generation Artificial Intelligence Development Report 2019," the volume of AI-related research papers in China has surged to a leading global position, with a substantial number of these papers focusing on foreign language teaching.

Rapid Expansion (2021-2024): From 2021 onward, the number of publications on AI in foreign language education experienced a pronounced surge. In 2022, there were 13 papers published, which escalated dramatically to 33 papers in 2023, more than doubling the previous year's output. This rapid increase underscores the growing scholarly interest as AI technology advances and its impact on foreign language teaching becomes more evident.

6.2. Analysis of the Research Process of Foreign Language Teaching Empowered by Artificial Intelligence Abroad

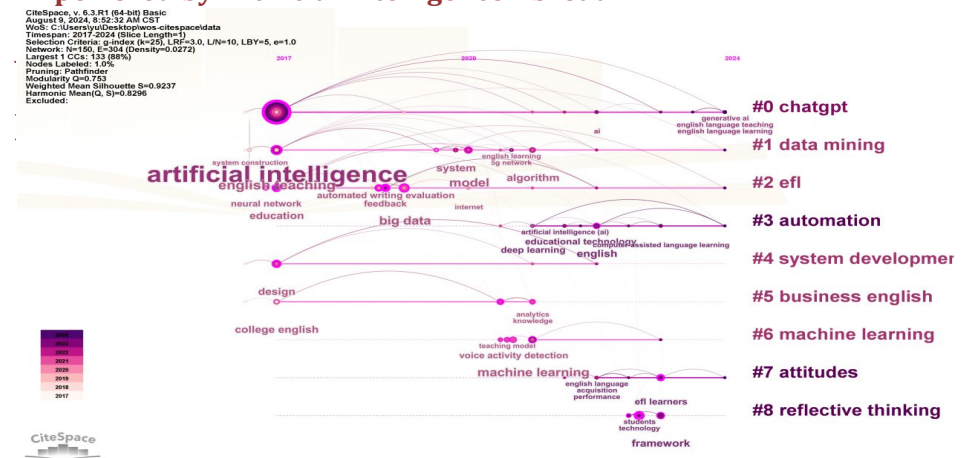


Figure 3. Keywords time zone graph abroad

It can be seen that this research field has received more attention and discussion after 2017. After 2017, more network nodes appeared, so the relevant research achievements from 2014 to 2024 are also divided into three stages, namely, the initial stage from 2014 to 2016, the slow development stage from 2017 to 2020, and the rapid development stage from 2021 to 2024. The initial stage (2014 - 2016): there is no publications recorded in the first three years (2014-2016). The fact indicates that the academic community abroad may have still been in the exploratory and awareness phase regarding the application of artificial intelligence in foreign language teaching in the early stages, and had not yet developed a widespread research enthusiasm. The slow development stage (2017-2020): the number of publications suddenly increased, which may mark the beginning of growing interest among scholars in this field. In the following years, while the number of publications fluctuated, it generally showed a trend of slow growth.

The rapid development stage (2021- 2024): starting in 2021, there was a significant increase in the number of publications. An increasing number of scholars began to recognize the potential and value of AI in foreign language teaching and actively engaged in related research. Although the number of publications in 2023 and 2024 decreased compared to 2022, it remained at a high level (20 and 17 publications, respectively).

7. Conclusion

This paper employs scientometric techniques to conduct a visual analysis of the annual publication volume, high-frequency keywords, keyword clustering, and keyword evolution in research on foreign language teaching empowered by artificial intelligence. The study found that both domestic and foreign researches are interested in using AI to enhance foreign language teaching efficiency and personalization. Domestically, the focus is on optimizing existing models through data analysis and intelligent tutoring systems, while internationally, research tends to explore AI's role in creating interactive, immersive learning experiences and fostering technological innovation and cross-cultural adaptability. Besides, the researches on foreign language teaching empowered by artificial intelligence have focused on university-level English both domestically and internationally, while there are relatively fewer studies on other educational stages.

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