Visual Analysis of Research Trends on Language Teachers in the Era of Artificial Intelligence

Tong Chu[1,*], Wanyong Wang[1], Xiujuan Chen[1]

[1]School of Foreign Language Education, Jilin University, Changchun, China
[*]Corresponding author

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Abstract: This study reviews and analyzes language teacher research in the era of artificial intelligence between 2013 and 2023 using CiteSpace. The results indicate that research hotspots encompass language teachers' technological integration ability, affective attitudes, teaching content, and instructional effectiveness. The developmental trajectory of the research is evident in the shift of language teachers' instructional content from PCK to TPACK, the exploration of language teachers' affective research from internal beliefs to external environments, and the evolution of language teachers' educational technology from CALL to AI.

1. Introduction

The application of artificial intelligence (AI) in language education has become increasingly widespread, significantly impacting language teachers. AI technology has revolutionized teaching techniques both inside and outside the classroom, influencing teachers' emotions. Consequently, research on language teachers in the context of AI has rapidly emerged as a prominent field of study. This paper aims to analyze the research on language teachers in the era of AI over the past decade, using a precise search of the Web of Science Core Collection database. By employing a combination of bibliometric analysis and content analysis, we examine 423 research papers to identify hotspots, trace the development history, and predict future trends. Our analysis utilizes the visualization tool CiteSpace and content analysis methods to provide scholars in this field with insights into the international frontiers and future directions of research on language teachers in the era of AI.

2. Research Method

This study employed CiteSpace software and utilized keyword retrieval criteria and steps for visual analysis to uncover the research hotspots, developmental history, and future trends of language teacher research in the era of artificial intelligence (AI) between 2013 and 2023 (until June). The bibliometric data was sourced from the Web of Science Core Collection database. Drawing on the research findings of Huang Guozhen's team, renowned scholars in machine learning[1], the search terms for 'language teacher' and 'artificial intelligence' were expanded to

include similar English terms. Specifically, search terms such as 'Language Teacher', 'EFL Teacher', and 'ESL Teacher' were used to represent language teachers. For artificial intelligence, search terms like 'Artificial Intelligence', 'Machine Intelligence', 'Intelligent Support', 'Natural Language Processing', 'Chatbot', 'Intelligent System', 'Robot', and 'TPACK' were employed. These two sets of search terms were combined, and a literature search was conducted from January 2013 to June 2023. The initial database retrieval yielded 1,447 papers, which underwent further manual verification, resulting in a final selection of 423 research papers.

A combination of bibliometric analysis and content analysis was employed to analyze the literature data. The data from 423 papers was processed using CiteSpace's keyword co-occurrence cluster analysis. This analysis identifies clusters of keywords that frequently appear together, allowing for a deeper understanding of the interconnections within the research. Furthermore, CiteSpace's timeline function was employed to visualize the development trajectory map.

3. Research Hotspots

The keyword co-occurrence cluster analysis conducted by CiteSpace generated a keyword co-occurrence map for research on language education in the era of artificial intelligence, as depicted in Figure 1. The size of the nodes in the map indicates the frequency of occurrence of keywords. By conducting content analysis and reviewing literature associated with these high-frequency keywords, the author has identified the following hot topics in research on language teachers in the era of artificial intelligence:
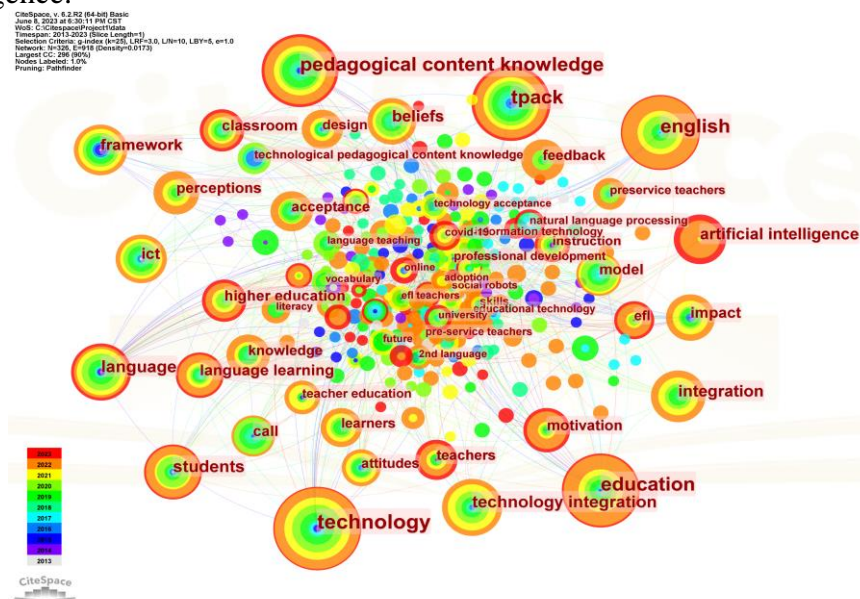

Figure 1: Keyword Co-occurrence

3.1 Beliefs and Attitudes of Teachers towards Technology Integration

The co-occurrence of keywords such as 'beliefs', 'motivation', and 'technology integration' suggests that research focuses on exploring teachers' beliefs and attitudes towards integrating technology in the classroom and how they influence teachers' use of technology. This area of research can be categorized into three aspects: First, teachers' beliefs and attitudes towards technology integration: Studies investigate teachers' beliefs and attitudes regarding the integration of technology in language teaching[2]. Second, factors affecting technology integration: Research examines factors that influence teachers' integration of technology in language teaching. Third,

professional development for technology integration: Studies explore the role of professional development in enhancing teachers' ability to integrate technology in language teaching.

3.2 Pedagogical Content Knowledge and Technology Integration

The co-occurrence of keywords such as 'pedagogical content knowledge' and 'technology integration' highlights the research focus on how teachers integrate technology into their teaching to enhance student learning outcomes. This line of research encompasses three main aspects: teacher's ability to integrate technology; teacher training and professional development; the impact of technology on teaching.

3.3 The Impact of Artificial Intelligence on Language Learning

The presence of high-frequency keywords such as 'artificial intelligence' and 'language learning' indicates the interest of researchers in exploring how artificial intelligence technology affects language learning. This area of research examines the effectiveness and challenges of AI-assisted language learning, providing valuable insights and inspiration for language teachers.

4. Research Development Trajectory

An analysis of the international literature on language teachers in the era of artificial intelligence not only reveals research hotspots but also provides insights into the development trajectory of this field. The author utilized CiteSpace to generate a timeline map depicting changes in research hotspots concerning language teachers and artificial intelligence (see Figure 2). This map elucidates the research development trajectory based on keywords and their corresponding timelines.
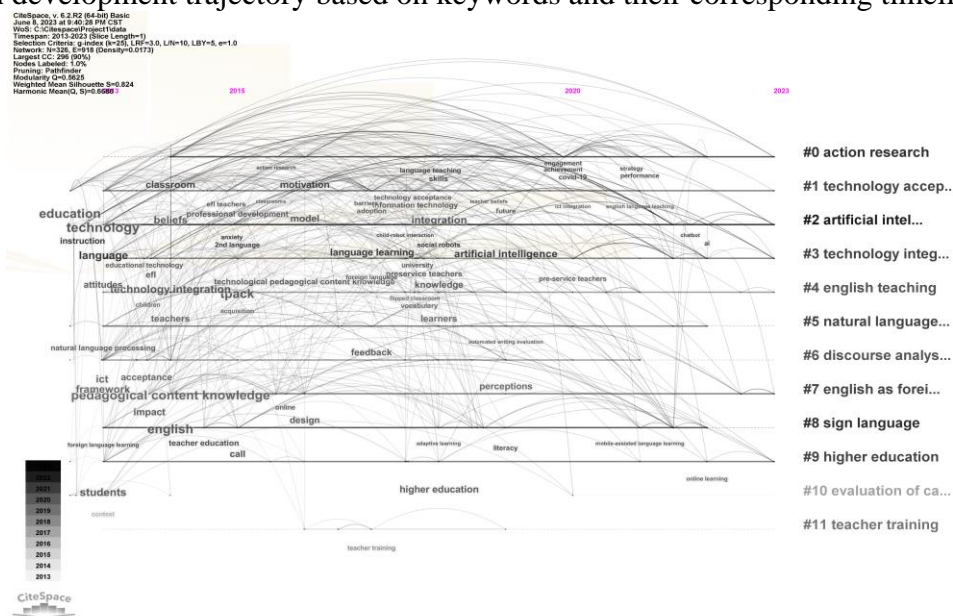

Figure 2: Research development trajectory of language teachers and technology.

4.1 The Development of Teacher's Teaching Content from PCK to TPACK

Figure 2 illustrates a progression in teachers' teaching content from Pedagogical Content Knowledge (PCK) to Technological Pedagogical Content Knowledge (TPACK). The development of pedagogical content knowledge has a long history, with research on technology integration by

language teachers in English courses emerging in 2014[3]. Since then, language teachers have been incorporating digital technology into language teaching, focusing on barriers to technology adoption and professional development for technology integration. The appearance of the keyword 'technological pedagogical content knowledge' in 2016 indicates that language teachers are continually integrating science and technology into their teaching content. Research in this area primarily focuses on TPACK in different contexts, TPACK assessment, and TPACK development. Future studies will likely explore how language teachers integrate science and technology into teaching content in various contexts, including hardware integration (mobile devices, computers, etc.), utilization of network resources, and emerging technologies such as artificial intelligence.

4.2 The Transformation of Teacher Emotion Research from Focusing on Internal Beliefs to Focusing on External Environment

As science and technology progress, researchers have increasingly recognized the transformation of language teacher emotions. They have discovered that internal factors, such as beliefs, can act as incentives or barriers that facilitate or hinder mobile technology integration[4]. However, the impact of technology integration on emotions is bidirectional, affecting not only teachers but also students. As depicted in Figure 2, from the appearance of 'beliefs' in 2014 to the introduction of 'motivation' keywords in 2016, research in this field gradually shifted from focusing on the influence of information technology on teacher beliefs to its impact on learner motivation. For instance, studies have investigated the effects of using robots to assist language learning on learner motivation 错误!未找到引用源。. By 2020, the emergence of 'COVID-19' indicated that the necessity of utilizing online teaching-related technologies presented challenges to language teachers' emotions and altered their practices. In the post-pandemic era, designing high-quality online courses necessitates researchers to consider the impact of the external environment on teacher emotions, such as the influence of generative artificial intelligence (e.g., ChatGPT) on language teachers.

4.3 The Development of Teacher's Educational Technology from CALL to AI

Figure 2 highlights the development trajectory of teachers' educational technology, progressing from Computer-Assisted Language Learning (CALL) to Artificial Intelligence (AI). In 2015, the keyword 'CALL' emerged, representing early research on how language teachers perceived, developed, and utilized[5] CALL knowledge and skills in professional development programs. By 2019, the increased frequency of the keyword 'artificial intelligence' indicated the emerging impact of AI on language teachers. Studies were already investigating the use of AI-based writing assessment systems to reduce teacher workload and assisting teachers in applying AI technology in foreign language education. In 2022, the reemergence of the keyword 'AI' alongside the simultaneous appearance of 'chatbot' indicated the renewed attention given to AI in this field. Numerous studies have since emerged, exploring AI development for language education, training for AI translation, and the use of AI support by teachers for language learning. It is evident that the advent of generative artificial intelligence has revolutionized educational technology for language teachers and has become a promising emerging technology in language teaching.

5. Future Research Prospects

Research on language teachers in the era of artificial intelligence is an emerging and important topic in the field of language education. While some progress has been made, there are still challenges and areas for improvement. To foster further development and innovation in this field, this paper proposes four areas for future research prospects based on current research status and

existing gaps.

5.1 Enhancing the Ability of Language Teachers to Integrate Technology to Help Them Adapt to Teaching Scenarios and Needs

For a long time, teachers' self-efficacy and post-success feelings regarding technology teaching have played a crucial role in their intentional and actual use of technology. Technology integration ability refers to teachers' capability to incorporate electronic software or hardware into classroom activities to support students' learning of specific content. With the continuous development and innovation of artificial intelligence technology, language teachers need to continually update and improve their ability to integrate technology effectively. They should be able to seamlessly combine artificial intelligence technology with teaching content, methods, goals, and evaluation to adapt to diverse teaching scenarios and needs.

5.2 Deepening Understanding of Language Teacher Emotions to Promote a Positive and Open Attitude towards Artificial Intelligence

The current psychological framework of cognitive theory suggests that learning is an active and meaningful process influenced by an individual's existing understanding, beliefs, attitudes, and preconceptions. These theories also apply to understanding how language teachers learn about and interact with artificial intelligence technology. Therefore, it is important to consider the subjective feelings and emotional responses of language teachers during their interaction with artificial intelligence, as these factors significantly impact their acceptance and use of the technology. Future research can contribute to a deeper understanding of language teacher emotions and promote a positive and open attitude towards artificial intelligence technology among language teachers.

5.3 Mining the Potential of AI Teaching and Promoting Intelligent Teaching by Language Teachers

Numerous studies have emerged on the application of artificial intelligence (AI) in education, presenting new opportunities, potential, and challenges to educational practice. In foreign language teaching, technology-enhanced platforms for automated assessment of writing, translation, and dictation are gaining traction. These platforms can intelligently check the accuracy of learners' responses, reducing the workload of language teachers. Additionally, AI-based detection platforms can provide teaching feedback with consistent and intuitive evaluation criteria. Consequently, language teachers need to enhance their ability and proficiency in utilizing AI technology for intelligent teaching. However, empirical research exploring the teaching impact of AI in the EFL context from the perspective of teachers remains limited.

Future research should provide systematic guidance and support to language teachers in areas related to AI teaching, such as knowledge, skills, attitudes, and more. It is essential to deeply explore the opportunities and challenges presented by AI technology for language teachers in the new era. This includes alleviating negative emotions and promoting acceptance and effective utilization of the potential of AI teaching. Online platforms or mobile devices can also be utilized to design training content and services for language teachers on AI technology. This would allow language teachers to personalize their training plans and activities according to their needs and progress, while fostering communication and collaboration with other language teachers or experts.

5.4 Optimizing Artificial Intelligence Technology and Establishing a Collaborative and Complementary Relationship between Humans and Machines

The rapid development of artificial intelligence (AI) has garnered significant attention from researchers in the fields of computer science and education. AI technology holds immense potential and offers a wide range of applications in the field of language education. These applications include automatic assessment systems, neural machine translation tools, intelligent tutoring systems (ITS), artificial intelligence chatbots, and intelligent virtual environments. For instance, language teachers can utilize AI technology to assess students' language proficiency and progress accurately and efficiently, providing automatic revision suggestions. AI technology can also be employed to build neural networks that deliver more efficient translation services, enhance language learners' language knowledge through intelligent human language interaction, and provide personalized teaching materials based on learner models for individualized tutoring.

However, it is important to note that AI technology in the field of language education is still emerging, and further optimization is needed to align it with the needs of language teachers. This optimization should focus on strengthening human-machine collaboration and establishing a complementary relationship between language teachers and AI technology. Additionally, it is crucial to explore the ethical impacts and risks associated with artificial intelligence in language education.

Acknowledgements

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