

A Bibliometric Analysis of AI-supported Teacher Education

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ABSTRACT: Teacher education has undergone substantial transformation in recent decades, particularly with the rapid integration of artificial intelligence (AI)–driven educational technologies into training and professional development programs. These advancements have reshaped pedagogical approaches, instructional design, and the overall structure of teacher preparation. To provide a comprehensive understanding of the scientific development in this domain, this study systematically examines the application of AI in teacher education over the past 25 years. A total of 107 peer-reviewed articles were carefully screened and selected from two major academic databases, Scopus and the Web of Science (WoS) Core Collection. Using bibliometric analysis, this study identifies key publication trends, influential authors, collaborative networks, and emerging research themes. The findings reveal a consistent and significant increase in scholarly attention toward AI-assisted teacher education, particularly in the last decade. Moreover, the impact of AI is no longer confined to pre-service teacher training but has expanded to support continuous, lifelong professional development. AI technologies such as intelligent tutoring systems, adaptive learning platforms, and data-driven decision-making tools, are increasingly being utilized to enhance teachers' instructional competencies, reflective practices, and personalized learning pathways. Importantly, the analysis highlights a recent surge in the adoption of generative AI within teacher education, especially over the past two years. This development signals a paradigm shift, where AI is not only used as a supportive tool but also as a co-creator of educational content and pedagogical strategies. As a result, teacher training models appear to be entering a new phase characterized by innovation, personalization, and increased reliance on human–AI collaboration. Overall, this study provides valuable insights into the evolving landscape of AI in teacher education and underscores its growing significance in shaping the future of teaching and learning.

KEYWORDS: AI, artificial intelligence; teacher education; teacher training; teacher professional development; bibliometric analysis; literature review

1. Introduction

Teacher training programmes are undergoing significant changes, with educational technology playing a particularly dramatic role. This integration closely combines advanced technology and teaching practice, aiming to promote in-depth changes in education [1]. Educational

technology has been widely validated, showing not only positive effects on improving teachers' professional capabilities but also significant enrichment of students' learning experiences [2]. The key to achieving such outcomes lies in educational technology's ability to provide flexible and personalized learning pathways that support teachers in enhancing their teaching skills and professional competence [3].

Teachers often struggle to keep up with rapid technological advancements, which are critical for improving the quality of education [4]. To address this, teacher development programmes need to broaden their focus and consider a variety of training approaches [5]. These trainings should emphasize developing teachers' digital teaching and learning skills [6], using technology to increase participant engagement in virtual learning environments [7], and promoting the effective use of online learning platforms and educational applications [8, 9]. Research shows that such technologies can improve teacher productivity, teaching ability, and student engagement [10]. However, successful implementation requires appropriate training and support systems [9], as well as positive drivers for actual use [11].

AI is gradually optimizing teacher education. Learning analytics and machine learning algorithms are being cleverly integrated into teacher education to analyze behavioral data, discourse data, and statistical information [12]. They support teacher development through avatar-guided teaching simulations [13]. In addition, AI can efficiently perform daily tasks such as grading and providing feedback [14], support various management and teaching functions [15], and allow teachers to focus more on personalized teaching and student interaction [14].

However, integrating technology into teaching also presents challenges. Some researchers argue that emerging technologies, such as mixed reality or AI-supported virtual reality, have a dual impact on learning and teaching [16]. On one hand, technology may affect teachers' face-to-face interaction with students, potentially impacting the integrity of the teaching experience [17]. On the other hand, teachers must continuously learn and master new technologies to meet educational needs. Yet, lack of competency, limited instructional design, and time constraints remain common challenges [18].

In summary, although the application of educational technologies, including AI, in teacher education and training programmes has gradually become widespread, effectively using these technologies to support teaching still requires deeper research. This paper aims to review the current research on AI-supported teacher education and provide suggestions for future research and practical applications.

The objective of this paper is to examine the application of AI-supported educational technology in teacher education, particularly focusing on the current status of teacher training programmes. Based on these objectives, this article analyzes current research publications to interpret the impact of AI on teacher training, gaining a better understanding of the potential and limitations of AI in promoting teacher professional development. Ultimately, it seeks to provide valuable references for supporting teachers' professional growth by addressing the following research questions: What is the current research status and focus of AI-supported teacher education?; What are the possible future research trends in AI-supported teacher education?

2. Methodology

2.1. Bibliometric analysis.

Bibliometric analysis, a subfield of scientometrics, employs mathematical and statistical methods to examine and evaluate scientific literature, aiming to study and analyze scientific activity. By conducting quantitative research on publications, bibliometric analysis helps researchers make sense of large amounts of unstructured data, revealing cumulative scientific knowledge and evolutionary trends in a given field [19]. With the gradual development and improvement of databases, relevant scientific literature has become increasingly accessible, providing the necessary data foundation for research using bibliometric techniques [20]. This paper aims to investigate the current use of AI-related educational technology in teacher development and analyze future trends by charting publication counts, keywords, and the influence of literature related to teacher and faculty professional training and education.

2.2. Research flow.

The data processing workflow comprises four major steps (Figure 1), beginning with the selection of databases. Following this, relevant data are collected from the chosen databases. The next crucial step is data analysis, where the collected data undergo bibliometric evaluation. Finally, the workflow culminates in the presentation of results, showcasing the findings derived from the analysis.



Figure 1. Research road-map.

2.2.1. Selection of databases and analysis tool.

The initial step of this research involved identifying the databases to be used. To retrieve relevant academic literature on the topic, two databases were selected: Scopus and the Web of Science (WoS). WoS Core covers a wide range of disciplines, including natural sciences, engineering, medicine, and social sciences. Scopus, one of the largest abstract and indexing databases worldwide, offers an extensive collection of publications across technology, medicine, and social sciences. Additionally, this study utilized Biblioshiny, a user-friendly data analysis tool developed by Massimo Aria from the University of Naples, Italy. Biblioshiny is based on the Bibliometrix package and built on the Shiny framework in the R programming language, enabling streamlined and efficient analysis of bibliometric data.

2.2.2. Data collection.

To ensure a systematic and rigorous selection of relevant literature from the two databases, a flowchart based on the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework was constructed. The process is divided into three main stages: identification, screening, and inclusion (Figure 2). In the identification stage, we performed comprehensive searches in both Scopus and Web of Science (WoS) using carefully selected keywords related to AI and teacher education.

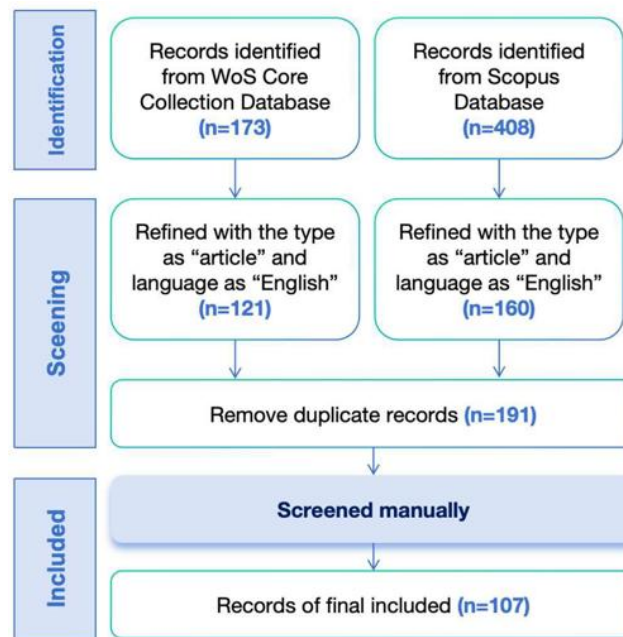


Figure 2. PRISMA flow diagram.

This step aimed to capture the broadest possible set of publications relevant to the study’s objectives. During the screening stage, duplicate records were removed, and titles and abstracts were examined to exclude publications that did not directly focus on AI-supported teacher education. Additional exclusion criteria included non-English publications, conference abstracts without full papers, and articles outside the defined publication period. Finally, in the inclusion stage, full-text articles were reviewed to ensure their relevance and suitability for bibliometric analysis. Only studies that directly addressed AI applications in teacher education and training programs were retained for the final dataset. This structured, multi-stage approach allowed for a transparent and reproducible process, ensuring that the selected literature accurately reflected the current research landscape in AI-supported teacher education.

2.2.3. Literature search strategy.

For the Web of Science (WoS) Core Collection database, the “Topics” search field was selected, which covers authors, titles, abstracts, and keywords. The search was conducted using the following keywords:

(AI OR “artificial intelligence”) AND (“teacher education” OR “teacher training” OR “teacher professional development” OR “faculty training” OR “faculty professional development”)

This search retrieved a total of 173 articles. For the Scopus database, the “TITLE-ABS-KEY” option was used with the same set of keywords, resulting in 408 articles. Both searches were performed to capture a comprehensive and representative set of publications addressing AI applications in teacher education and professional development.

2.2.4. Inclusion and exclusion criteria.

To refine the dataset, only articles published in English and classified as “articles” were included, which reduced the initial retrieval to 121 articles from WoS and 160 articles from

Scopus. After removing duplicates between the two databases, a total of 194 unique articles remained. These articles then underwent a manual screening process, where their titles, keywords, abstracts, and, when necessary, full texts were carefully examined to assess their relevance to the theme of AI-supported teacher education. Following this rigorous evaluation, 107 studies were deemed relevant, having met both the predefined search strategy and inclusion criteria (Figure 2).

3. Results

A total of 107 documents were retrieved, covering the period from 1 January 1999 to 14 July 2024. The Biblioshiny sub-tool of Bibliometrix was used to extract and analyze bibliometric data. Figures 3–5 summarize the annual scientific production, most relevant sources, and top authors, providing a comprehensive overview of research trends in AI-supported teacher education.

3.1. Annual scientific production.

As illustrated in Figure 3, the annual scientific production on AI-supported teacher education demonstrates a pronounced upward trajectory, reflecting the growing academic and practical relevance of this field. In the early stage (prior to 2009), research output was extremely limited, with only five publications identified. This scarcity suggests that the application of AI in teacher education was still in its infancy, constrained by both technological limitations and limited awareness of its pedagogical potential.

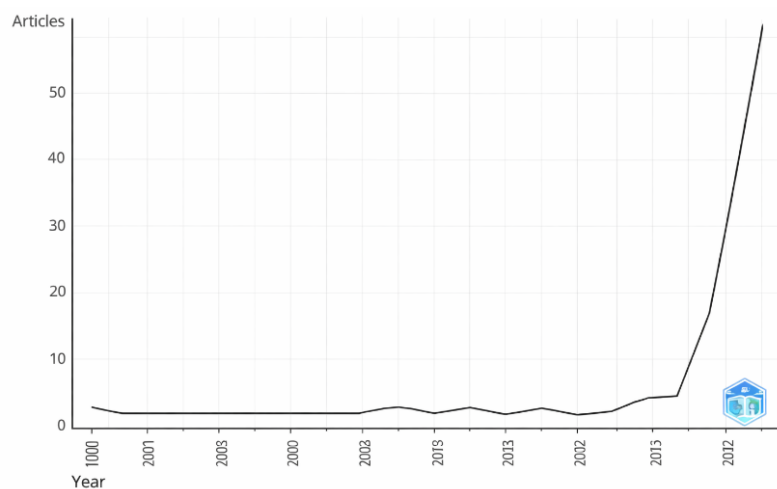


Figure 3. Annual production.

Between 2010 and 2021, the number of publications increased gradually, with an average annual growth of two to four articles. This period can be characterized as a developmental phase, during which foundational concepts such as intelligent tutoring systems, early adaptive learning technologies, and basic learning analytics, began to be explored within teacher education contexts. Although growth remained moderate, it indicates a steady expansion of scholarly interest and the gradual integration of AI into educational research agendas.

A significant inflection point occurred in 2022, when the number of publications rose sharply to 13 articles. This surge marks the transition from gradual growth to accelerated research activity. Notably, publications from 2022 to 2024 account for 87.9% of the total dataset, underscoring the rapid intensification of research efforts in recent years. This dramatic

increase can be attributed to several converging factors, including advances in machine learning technologies, increased accessibility of AI tools, and the global push toward digital transformation in education following the COVID-19 pandemic. Furthermore, the recent emergence of generative AI technologies has likely contributed to this surge, opening new avenues for innovation in teacher training, instructional design, and professional development. Overall, the observed trend reflects a paradigm shift, where AI is increasingly recognized not merely as a supplementary tool but as a transformative force capable of reshaping teacher education systems and lifelong learning pathways.

3.2. Sources.

Figure 4 presents the 15 most relevant journals contributing to the field of AI-supported teacher education. Together, these journals account for 66 publications, representing 61.7% of the total documents analyzed. This concentration indicates that scholarly output is clustered within a relatively small group of core journals, suggesting the presence of well-defined publication outlets that serve as central platforms for disseminating research in this domain. Among these, *Education and Information Technologies* emerges as the leading journal, publishing the highest number of articles. Its prominence highlights its pivotal role in bridging the intersection between educational practice and technological innovation. Other notable contributors include *Educational Sciences* and *Computers and Education Open*, which, along with the top five journals, collectively account for approximately one-third of all publications.

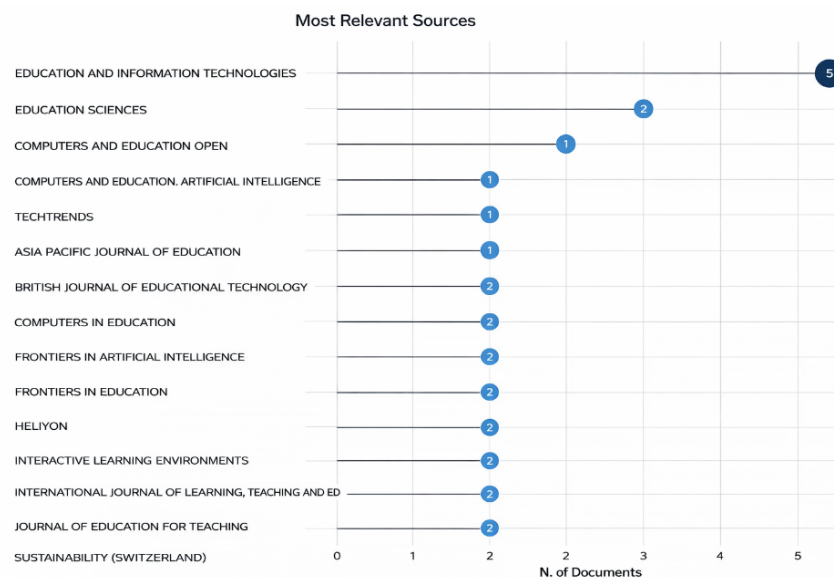


Figure 4. Most relevant sources.

This distribution reflects a dual pattern in the field's development. On one hand, it demonstrates increasing recognition of AI-supported teacher education across a range of educational and technological journals. On the other hand, it reveals a degree of specialization, where a limited number of journals function as primary hubs for scholarly communication and knowledge exchange. Such concentration may facilitate focused academic discourse and rapid knowledge accumulation, but it also suggests opportunities for broader dissemination across interdisciplinary platforms.

3.3. Authors.

Figure 5 illustrates the most productive authors in the field, highlighting the top 15 contributors based on publication output. The size of each node represents the number of articles published per year, providing a visual indication of research productivity and temporal engagement. Among these authors, Chiu T.K.F. ranks as the most prolific contributor, with three publications, while the remaining 14 authors have each produced two articles. This distribution suggests that the field is characterized by a relatively decentralized authorship structure, with no single dominant researcher. Instead, research activity is distributed among multiple contributors, each making modest but meaningful contributions to the development of the field.

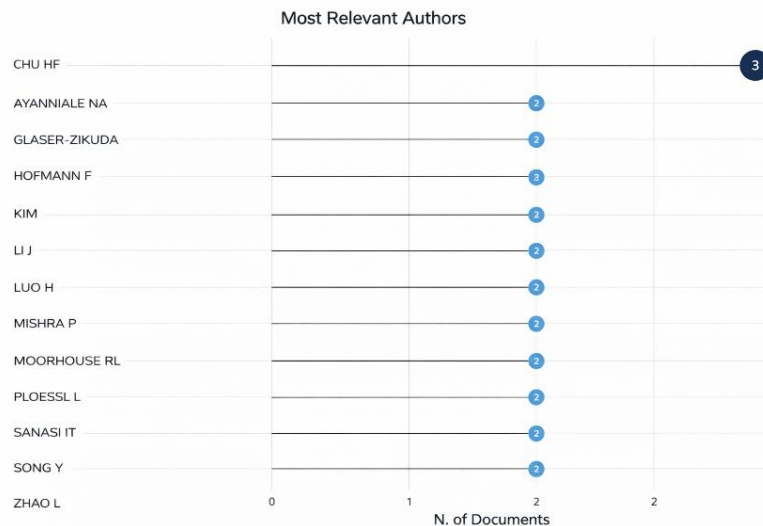


Figure 5. Most relevant author.

This pattern reflects the emerging and interdisciplinary nature of AI-supported teacher education. Scholars from diverse backgrounds—including education, computer science, and data analytics—are increasingly engaging with this topic, leading to a broad but still loosely connected research community. Additionally, the visualization indicates a growing trend toward collaboration, as evidenced by overlapping publication timelines and shared research interests. The absence of highly dominant authors may also indicate that the field is still in a formative stage, with ample opportunities for new researchers to contribute and shape its direction. As the field continues to mature, it is likely that more cohesive research networks and leading scholarly figures will emerge, further consolidating knowledge and advancing theoretical and practical developments.

3.4. Keywords and research focus.

Analysis of keyword frequency revealed that “artificial intelligence” was the most frequently used term (37 occurrences), followed by “teacher education” (22) and “teacher training” (15). Other prominent keywords included “teaching” (15) and “ChatGPT” (13). This highlights that the research primarily focuses on AI applications in teacher education and professional development, with emerging attention to generative AI technologies such as ChatGPT. The temporal evolution of topics indicates that interest in “artificial intelligence” and “teacher education” has grown steadily since 2021. By 2022, research topics began to diversify, emphasizing teacher training, teachers, and teaching. In recent years, ChatGPT and other

generative AI tools have emerged as focal points, signaling the beginning of a new frontier in AI-supported teacher education research.

3.5. Discussion.

The bibliometric analysis demonstrates that research interest in AI-assisted teacher education has steadily increased since 2019, with the application of AI gradually expanding across all stages of teacher professional development. In the past two years, generative AI has emerged as a particularly important area of study. The application of AI-supported educational technologies in teacher education has received growing attention due to its ability to enhance teachers' instructional competence while fostering professional growth. This study highlights trends in publication counts, key journals, author contributions, and core research keywords, showing a clear trajectory of expansion and influence. AI technologies have penetrated multiple aspects of teacher education, from traditional teacher preparation to short-term training programs and ongoing professional development. These technologies improve teachers' digital skills, enable personalized and flexible learning paths, and enrich the overall educational environment [21].

Frontier research in 2024 further emphasizes the potential of generative AI (GAI) in teacher training. To maximize GAI's effectiveness, educational institutions are encouraged to provide institutional support, integrate GAI into training programs, and develop innovative evaluation systems to assess its impact scientifically [22]. Moreover, AI and GAI are transforming traditional classroom models toward more intelligent and personalized approaches. Features such as intelligent question-and-answer systems and virtual experiments enhance classroom interaction, diversify teaching methods, and increase student engagement. Given the rapid evolution of GAI technologies, exploring optimal implementation strategies and practical models in educational settings remains a key direction for future research [23].

4. Limitation and Future Studies

While this study provides insights into the progress and trends in AI-assisted teacher education, it inevitably has certain limitations that are important for a comprehensive understanding and evaluation of the field. The first limitation concerns the scope of analysis. This study relies primarily on two major databases, Scopus and Web of Science. Although these databases are widely recognized and influential in academic research, their coverage is inherently limited and may not fully represent the entire field. Future research should aim to expand the diversity of data sources, allowing for a more comprehensive exploration of the potential benefits and challenges of AI-assisted teacher education. Broader data coverage could provide stronger evidence to support policymakers and educational practitioners.

The second limitation relates to data processing. Due to the current dataset size, this study could not conduct a more detailed and in-depth analysis of AI applications across different educational stages, such as primary, secondary, and higher education, or assess their differentiated impact on teachers' professional development. This limitation may obscure the unique roles and potential challenges of AI technology in various educational contexts. Future research should refine data segmentation and build a more detailed analytical framework to investigate the effects, challenges, and strategies associated with AI implementation across diverse educational scenarios. Such efforts would provide a scientific basis for the precise and effective deployment of educational technology.

Looking ahead, future research should focus on the deep integration of AI with other emerging educational technologies, aiming to more effectively enhance teachers' professional growth and development. A critical step is an in-depth examination of teachers' acceptance of AI technology and their practical needs, which can inform strategies to improve teachers' digital literacy and promote the overall digital transformation of the teaching workforce. Moreover, potential risks associated with AI in teacher training—such as privacy concerns and ethical issues—must be carefully addressed to ensure safe and responsible implementation.

4. Conclusions

This bibliometric study reveals that research on AI-assisted teacher education has grown substantially over the past 25 years, with a sharp increase in publications since 2022. The analysis of 107 articles shows that AI technologies are increasingly integrated into teacher training and professional development, reflecting the growing recognition of their potential to enhance teaching practices and improve educational outcomes. Key journals such as *Education and Information Technologies* and *Educational Sciences* serve as central platforms for disseminating research, while authorship remains relatively dispersed, indicating a broadening and increasingly collaborative research community. Keyword analysis highlights that core research topics focus on artificial intelligence, teacher education, teacher training, and teaching practices, with emerging interest in generative AI technologies such as ChatGPT. These findings indicate that the field is evolving rapidly, moving from foundational studies toward practical applications that support personalized, flexible, and innovative teacher training programs. Despite these advances, the study also underscores limitations, including reliance on two major databases and limited analysis across different educational stages. Future research should expand data sources, explore AI applications in diverse teaching contexts, and address emerging challenges such as ethical concerns and privacy risks. Overall, this study provides a comprehensive overview of AI-supported teacher education, offering insights that can inform policy, practice, and further research in advancing digital literacy, teaching competence, and innovative educational practices.

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Author Contribution

All authors contributed equally to this work. They were jointly involved in conceptualization, methodology development, data collection and analysis, interpretation of results, and manuscript preparation. All authors have read and approved the final version of the manuscript..

Competing Interest

The authors declare that they have no competing interests related to this work.

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