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Charting AI Integration in English Education: A Bibliometric Analysis of Emerging Trends, Ethical Dilemmas, and Theoretical Transformations

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Abstract

This study conducts a bibliometric analysis of Artificial Intelligence (AI) in English education, employing co-citation and co-occurrence analyses to investigate significant research trends, theoretical frameworks, and interdisciplinary connections. The analysis delineates four primary research clusters: AI-assisted language acquisition, ChatGPT in educational methodologies, AI chatbots for English as a Foreign Language (EFL) students, and AI-facilitated student engagement. The co-citation analysis identifies pivotal studies that influence the intellectual framework of the field, whereas the co-occurrence analysis underscores thematic trends and research deficiencies. This study enhances the Technology Acceptance Model (TAM) by integrating pedagogical and ethical aspects, illustrating the interaction between perceived ease of use, usefulness, policy frameworks, teacher readiness, and AI implementation in education. Notwithstanding AI's transformative potential, challenges persist, encompassing data privacy issues, algorithmic bias, ethical dilemmas, and the necessity for interdisciplinary collaboration. To connect AI with sustainable and equitable education, future research has to investigate the long-term adoption of AI, geographic disparities, and strategies for effective pedagogical integration. This study presents a framework for the ethical, effective, and interdisciplinary integration of AI in English education by promoting collaboration among educators, AI researchers, and policymakers.

Keywords: artificial intelligence, bibliometric analysis, English education, ethics, technology acceptance model

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1. Introduction

The integration of Artificial Intelligence (AI) in education has attracted increased scholarly attention, especially in the realm of English as a Foreign Language (EFL) teaching (Derakhshan & Park, 2026a). Recent studies examine the impact of AI on academic engagement and emotional well-being (Guo & Wang, 2024), teacher AI literacy (Pan & Wang, 2025), and classroom climate and resilience (Wang et al., 2025), as well as learners' achievement emotions and willingness to communicate (Chen et al., 2025). This increasing interest is primarily fueled by advances in large language models (LLMs), ethical AI frameworks, and personalized learning instruments. The function of AI in EFL education is being redefined by applications like ChatGPT and other AI-driven tools (Fathi et al., 2024; Lo, 2023).

AI-driven tools possess the capacity to revolutionize educational methodologies by individualizing learning experiences, enhancing engagement, and elevating academic achievement (Derakhshan & Park, 2026b; Mohamed, 2024; Mizumoto & Eguchi, 2023). Despite their potential, the implementation of AI in educational contexts, especially in language instruction, is a complicated and disjointed endeavor, beset by considerable challenges including technology integration, teacher readiness, and ethical issues (Derakhshan, 2025). The transformative potential of AI in English education is especially evident in the use of generative artificial intelligence (generative AI) models like ChatGPT, which aid in linguistic comprehension, participation, and real-time language processing (Wang et al., 2023). However, the use of AI tools raises serious concerns about the impact on traditional language skills such as cultural interpretation, in-depth linguistic analysis, and contextual adaptation (Kasneci et al., 2023; Weng et al., 2023). Furthermore, there are ongoing concerns about over-reliance on automated systems and the potential loss of critical human cognitive and interpretative abilities. It is imperative to maintain the integrity of language education by balancing technological support with human expertise. The United Nations Educational, Scientific, and Cultural Organization (UNESCO, 2021) has underscored the significance of utilizing AI in education in accordance with ethical and inclusive practices, thereby ensuring that technology is employed to empower rather than perpetuate inequality, in recognition of these challenges.

Current studies on AI in language education predominantly concentrate on the technical functionalities of AI tools, neglecting their pedagogical incorporation into curriculum development, student involvement, materials development, and skill

enhancement (Fathi et al., 2024; Park & Derakhshan, 2026). Moreover, although ethical concerns such as data privacy, algorithmic bias, and trust are often addressed in the broader AI dialogue (Kasneci et al., 2023), there is an absence of thorough ethical frameworks specifically designed for educational settings. Given the growing link between AI in education and the broader agenda of sustainable development, UNESCO (2020) emphasizes the importance of aligning AI-driven innovations with Sustainable Development Goal 4 (SDG 4), which seeks to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. This viewpoint emphasizes the importance of taking a balanced approach that considers AI's technological potential as well as pedagogical and ethical concerns.

This review systematically evaluates the existing literature on the role of AI in EFL instruction, focusing on AI-driven tools, integration challenges, and ethical considerations. Using co-citation and co-occurrence analysis, it investigates emerging themes and interdisciplinary connections that may influence future research in the domain. Furthermore, this study aims to improve existing theoretical frameworks, such as the Technology Acceptance Model (TAM) (Liu & Ma, 2024), by incorporating pedagogical and ethical considerations into our understanding of AI adoption in language education.

As a result, this study seeks to fill the aforementioned gaps by investigating the intersection of AI adoption, pedagogy, and ethics in the context of English education. The purpose of this research is to systematically investigate the integration of AI in English education by answering the following two research questions:

RQ1: What are the most prominent research trends, influential studies, and theoretical frameworks represented in published research papers on AI-powered English education?

RQ2: What emerging research topics and connections between different fields can be found by looking at how published studies on AI-powered English education relate to each other?

By providing a structured overview of the intellectual landscape, this study not only guides future research directions but also informs more responsible, equitable, and pedagogically sound AI integration in EFL education.

2. Literature Review

2.1. AI-Powered Tools in English Education

Prior research has looked into the use of AI in English language education, with many studies highlighting its ability to improve learning through personalized instruction, immediate feedback, and increased learner autonomy. AI-powered chatbots such as ChatGPT, which allow for interactive language practice and provide tailored feedback, are among the most extensively researched. Empirical evidence indicates that these tools can enhance learners' speaking and writing proficiency (Yang et al., 2022; Jeon, 2024; Zare et al., 2025). Song and Song (2023) discovered that AI-assisted writing tools markedly enhanced the academic writing performance and motivation of EFL students. Alongside cognitive advantages, recent studies have increasingly highlighted the emotional aspects of AI integration. Guo and Wang (2024) conducted a mixed-methods study demonstrating that the implementation of AI in EFL classrooms markedly improves students' academic engagement and cultivates more favorable emotional experiences. Similar findings regarding AI's influence on learners' achievement emotions have also been reported (Derakhshan & Park, 2026). Their findings highlight the capacity of AI tools to enhance academic performance and foster emotionally supportive learning environments (Pishghadam & Shakeebaee, 2020).

Nevertheless, despite these advantages, current research frequently neglects significant limitations–especially concerning the consistency and educational quality of AI-generated feedback. Belda-Medina and Calvo-Ferrer (2022) observe that AI chatbots encounter difficulties in recognizing nuanced linguistic inaccuracies and providing contextually suitable corrections. This raises concerns regarding students' potential overreliance on automated feedback, which may impede the cultivation of genuine language proficiency. Therefore, scholars increasingly call for a balanced instructional approach in which AI tools supplement, rather than replace, traditional human-led teaching methods.

2.2. Integration Challenges

The incorporation of AI into educational environments has been demonstrated to be a complex and disjointed endeavor. Although AI provides personalized learning, its integration into current educational frameworks is inconsistent. Kohnke et al. (2023) emphasize the significance of interdisciplinary collaboration in AI integration,

promoting enhanced cooperation among educators, linguists, and technologists. Despite the appeal for cooperation, a significant portion of the research continues to concentrate on the technical dimensions of AI, neglecting the pedagogical and institutional obstacles related to its implementation (Zawacki-Richter et al., 2019). Furthermore, research carried out by Nazari et al. (2021) and Wang et al. (2023) emphasize the potential of AI-driven tools to enhance learning outcomes; however, they seldom address the challenges related to institutional support and teacher readiness in the implementation of these tools (Burgess-Brigham et al., 2020; Pokrivcakova, 2019; Wu & Derakhshan, 2025). This gap in the literature underscores a pressing necessity for research that examines the extensive infrastructural and professional development obstacles affecting AI's efficacy in language education.

3. Methodology

3.1. Research Design

Bibliometric analysis offers a systematic framework design for examining the research corpus on AI in English education. This method employs statistical techniques to assess publications co-citations, and keyword co-occurrences. This research employed the Web of Science (WoS) database because it has a comprehensive coverage of high-impact, peer-reviewed journals in education and AI. This database guarantees a robust and dependable dataset for bibliometric analysis, ensuring consistency in citation indexing and metadata structure.

The main aim of this study's bibliometric analysis was to identify and examine the literature on the use of AI in English education. The investigation centered on articles published between 2020 and 2024 and was conducted through WoS database. A meticulously formulated search string was employed to acquire a substantial quantity of pertinent papers, incorporating keywords such as "artificial intelligence" or "AI," "English*," "educa*," and 'pedagogy" within the topic search field (TS). This method guaranteed the inclusion of all variations of these terms, thereby broadening the scope of the literature examined. Bibliometric analysis is instrumental in identifying prominent authors, essential research domains, and collaboration networks, facilitating a systematic examination of the existing literature.

3.2. Data Collection

To enhance the thoroughness and rigor of the search, the inclusion criteria were narrowed to encompass only peer-reviewed, English-language articles indexed in SSCI or SCI-Expanded. Table 1 delineates the explicit criteria employed in the selection process, encompassing language prerequisites and peer-reviewed status, guaranteeing that only high-caliber scholarly studies were evaluated. This methodology effectively mapped the research landscape of AI in English education by focusing on high-impact articles, providing insights into significant contributions and emerging trends in the field.

Table 1

Inclusion Criteria for Bibliometric Analysis

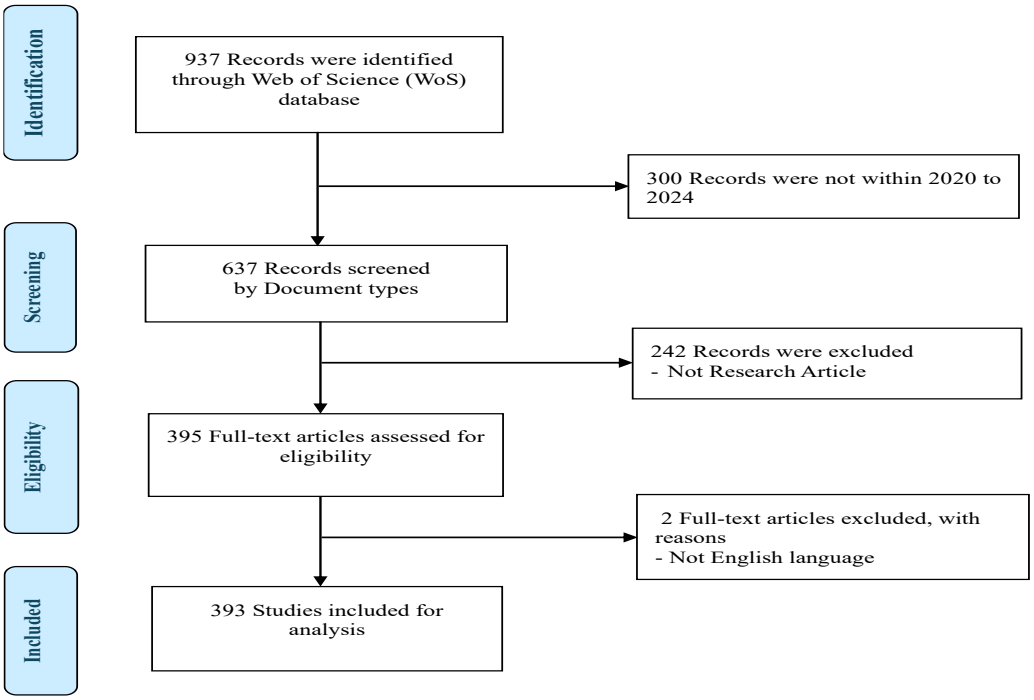
WoS Database	ALL
Time period	2020 to 2024
Search field	TS
Search keywords	((TS=("artificial intelligence" or "AI")) AND TS=("English*")) AND TS=("educa*" or "pedagogy")
Citation Topics Meso	ALL
Document type	Article
Language	English
Web of Science Index	SSCI or SCI-EXPANDED

To ensure the inclusion of high-quality, peer-reviewed studies aligned with the research focus, a systematic screening procedure was implemented. The initial dataset of 937 articles produced by this method was reduced to 393 pertinent publications to ensure the inclusion of high-quality, peer-reviewed studies aligned with the research focus. The methodical screening procedure is graphically depicted in Figure 1, which breaks it down into four essential steps:

- (Identification) A total of 937 records were obtained via extensive search methodologies.
- (Screening) Following the application of temporal filters (2020–2024), 637 records were retained.
- (Eligibility) This phase further eliminated records that were non-research articles, non-English, or not Open Access, resulting in a total of 395 full-text articles evaluated.

- (Inclusion) Ultimately, 393 high-quality research articles that fulfilled the criteria of relevance and rigor were chosen for bibliometric analysis.

Figure 1
PRISMA Flowchart



3.3. Data Analysis

The dataset comprising 393 articles was analyzed utilizing VOSviewer to conduct:

- Performance Analysis: to investigate the productivity and citation patterns of authors, journals, nations, institutions, and documents.
- Co-Citation Analysis: to identify studies that are frequently cited in order to uncover the intellectual structure.
- Co-Occurrence Analysis: to identify thematic relationships by examining the frequency and linkage of keywords.

These analyses enable the identification of research clusters, visualization of citation networks, and interpretation of emerging trends in the field of AI-enhanced English education.

4. Results

In this study, VOSviewer was employed for bibliometric analysis to generate citation, co-citation, and co-occurrence networks, so offering insightful analysis of the main trends in English education driven by AI. By analyzing the number of citations each publication received, citation analysis helped us to pinpoint foundational works in the field and identify the most important studies (Wider et al., 2024). Citation analysis helped us to pinpoint important writers and studies that helped the field to grow. By means of co-citation analysis, important writers and foundational studies were further identified, so exposing the works that are routinely cited together and stressing their central significance in the field of research. These co-cited studies, often focused on AI applications in education, pedagogical frameworks, and ethical considerations, underscore the interdisciplinary nature of the field and the thematic connections that drive current research (Kasneci et al., 2023).

Furthermore, co-occurrence analysis was employed to define the semantic structure of the research domain by determining the frequency and co-occurrence of key terms such as "generative AI," "English pedagogy," and "student engagement." Only keywords that appeared at least five times in the dataset were included, thereby highlighting frequent and conceptually relevant terms. The LinLog modularity clustering algorithm of VOSviewer was utilized to categorize semantically related terms into separate thematic clusters. This approach improved the conceptual clarity of prevailing research themes and illustrated their evolution over time (Chen et al., 2020b). Through this analysis, we detected recurring thematic clusters, which enabled a structured understanding of interrelated concepts. These findings highlighted emerging research directions that warrant further investigation. For example, Baidoo-Anu and Ansah (2023) and Fathi et al. (2024) emphasized that the integration of AI in English instruction not only fills critical gaps in the literature but also provides actionable insights for instructional design. The analysis was based on data from 393 publications, confirming the growing relevance of AI-enhanced English education.

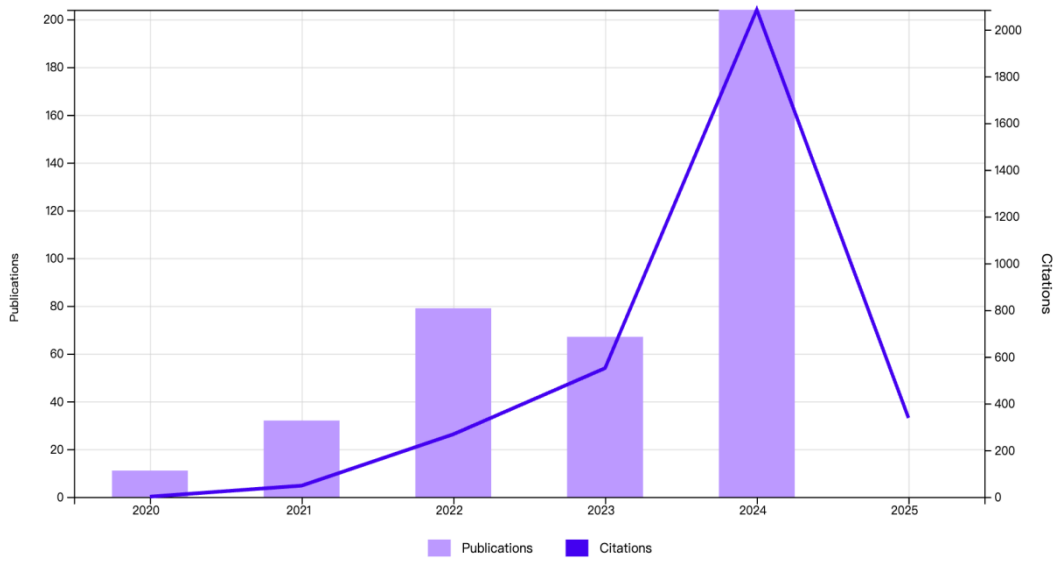
The bibliometric analysis of AI in English education also provided useful metrics that highlight the influence and development of this field. The identification of 393 publications from the WoS database between 2020 and 2024 revealed a substantial citation footprint. Specifically, these articles have received 2,382 citations overall (2,259 citations when self-citations are excluded), with an average

of 8.37 citations per publication. The depth and impact of the research were reflected in the H-index of 32, indicating that at least 32 of these articles have been cited at least 32 times. The H-index is a widely used metric that assesses both the productivity and citation impact of researchers or bodies of work.

Figure 2 illustrates the trajectory of publications and citations from 2020 to 2024. The bars (in light purple) denote the number of publications, whereas the line (in dark blue) indicates the number of citations. The figure illustrates a consistent rise in citations and publications, with a sharp peak in 2024, reaching approximately 2,000 citations and 180 publications. This signifies an increasing scholarly interest in the domain, with additional studies enhancing the continuous research and development efforts. This trend indicates a growing acknowledgment of the significance of AI-driven advancements in English education. The strong citation counts and the increasing volume of scholarly work highlight the field's dynamic nature and scholarly importance, while also pointing to areas for further research. In summary, the bibliometric analysis reveals a steady increase in the number of publications and citations between 2020 and 2024, with significant growth in 2024. This rise reflects the growing interest and relevance of AI in English education, marking the field's increasing significance.

Figure 2

Quantity of publications and citations (2020–2024)



4.1. Performance Analysis

Performance analysis is a fundamental bibliometric technique used to assess productivity and scholarly impact across documents, authors, institutions, and countries (Donthu et al., 2021). The performance analysis of AI in English education reveals significant contributions across key dimensions including documents, authors, sources, organizations, and regions, demonstrating the extensive research in this field. To facilitate the structured presentation, the data that comes next is provided prior to analysis and interpretation:

- Documents: The temporal distribution of publications and their citation influence.
- Sources: Key academic journals contributing to AI in English education research.
- Authors: Leading scholars and their influential contributions to the field.
- Organizations: Prominent universities and research institutions driving AI integration into English education.
- Regions: Worldwide dissemination of research contributions and patterns of c ollaboration.

An extensive analysis and interpretation of significant trends, research deficiencies, and emerging trajectories in AI-driven English education research will be presented.

4.1.1. Documents

Table 2 lists the top 10 most cited research articles in AI and English education, highlighting their academic impact. The most commonly referenced articles emphasize the increasing significance of AI technologies in English education and their educational ramifications. The study by Sun et al. (2021) on online intelligent English teaching platforms has garnered 137 citations, indicating its influence on AI-assisted education. Nazari et al. (2021) and Huang et al. (2023b), both with 93 citations, have made substantial contributions to AI-powered digital writing assistants and AI-driven language education trends. Other key contributions include Mohamed (2024) (85 citations) on AI chatbots for EFL teaching and Song & Song (2023) (67 citations) on the efficacy of ChatGPT in AI-assisted language learning. The high citation frequency of these works underscores the increasing focus on AI's practical applications in English education and its ethical implications. The diversity of research topics–ranging from chatbot integration to adaptive learning–

reflects the complexity and dynamic nature of AI applications in English education.

Table 2
Top 10 Most Cited Articles

Rank	Authors	Title	Citations
1	Sun et al. (2021)	Design of Online Intelligent English Teaching Platform Based on Artificial Intelligence Techniques	137
2	Nazari et al. (2021)	Application of Artificial Intelligence Powered Digital Writing Assistant in Higher Education: Randomized Controlled Trial	93
3	Huang et al. (2023b)	Trends, Research Issues, and Applications of Artificial Intelligence in Language Education	93
4	Mohamed, A. M. (2024)	Exploring the Potential of an AI-Based Chatbot (ChatGPT) in Enhancing English as a Foreign Language (EFL) Teaching: Perceptions of EFL Faculty Members	85
5	Song, C., & Song, Y. (2023)	Enhancing Academic Writing Skills and Motivation: Assessing the Efficacy of ChatGPT in AI-Assisted Language Learning for EFL Students	67
6	Wang et al. (2023)	What Matters in AI-Supported Learning: A Study of Human-AI Interactions in Language Learning Using Cluster Analysis and Epistemic Network Analysis	66
7	Yang et al. (2022)	Implementation of an AI Chatbot as an English Conversation Partner in EFL Speaking Classes	61
8	Belda-Medina & Calvo-Ferrer (2022)	Using Chatbots as AI Conversational Partners in Language Learning	60
9	Mageira et al. (2022)	Educational AI Chatbots for Content and Language Integrated Learning	54
10	El Shazly, R. (2021)	Effects of Artificial Intelligence on English Speaking Anxiety and Speaking Performance: A Case Study	52

4.1.2. Sources

Table 3 lists the top ten most cited journals in AI and English education research, highlighting their impact through publication volume and citations. Several academic journals have emerged as important outlets for AI research in English education. Education and Information Technologies lead with 34 documents and 361 citations, reinforcing its position as a focal point for discussions about AI-enhanced pedagogy. Followed by journals such as System and Frontiers in Psychology, demonstrating interdisciplinary intersections between technology, education, and cognitive sciences, with 11 documents and 123 citations and 9 articles and 122 citations, respectively. In addition, Computers in Human Behavior with 8 documents and 51 citations, and the European Journal of Education featuring

8 publications and 54 citations have offered critical insights into AI's role in language acquisition, engagement, and educational policy frameworks. This breadth of sources highlights the growing recognition of AI as a transformative force in language education.

Table 3
Top 10 Most Cited Journals

Rank	Journals	Documents	Citations
1	Education and Information Technologies	34	361
2	Mobile Information Systems	13	46
3	System	11	123
4	Wireless Communications & Mobile Computing	11	53
5	Frontiers in Psychology	9	122
6	Interactive Learning Environments	9	86
7	Mathematical Problems in Engineering	9	14
8	Computational Intelligence and Neuroscience	8	21
9	Computers in Human Behavior	8	51
10	European Journal of Education	8	54

4.1.3. Authors

Table 4 enumerates the ten most cited authors, detailing their publication totals and citation impact, illustrating their prominence in AI and English education research. Di Zou is at the forefront of the academic discourse, with five publications and 117 citations, highlighting their significant impact in this field. Hui Pang, Xinghua Wang, and Matthew P. Wallace each contribute two publications and 112 citations, demonstrating their significant involvement in AI-driven English education research. Tzeng-Ji Chen (2 documents, 111 citations) and Gary Cheng (3 documents, 100 citations) are important contributors, highlighting the wide range of research efforts influencing AI English education. The ongoing involvement of these scholars in AI English education literature represents a growing research community dedicated to improving AI-based learning models and pedagogy.

Table 4
Top 10 Most Cited Authors

Rank	Authors (Year)	Documents	Citations
1	Zou, Di (2023)	5	117
2	Pang, Hui (2023)	2	112
3	Wallace, Matthew P.(2023)	2	112
4	Wang, Xinghua (2023)	2	112
5	Chen, T.-J. (2023)	2	111
6	Wang, Y.-M. (2023)	2	111
7	Cheng, Gary (2023)	3	100
8	Xie, Haoran (2023)	3	100
9	Chen, Xieling (2023)	2	99
10	Huang, Xinyi (2023)	2	99

4.1.4. Organizations

Table 5 lists the top ten most cited institutions for AI-driven English education research. The Education University of Hong Kong leads with 12 publications and 188 citations, followed by the Chinese University of Hong Kong with 11 publications and 192 citations, indicating a strong research presence in AI-enhanced language education. Other significant contributors include Nanyang Technological University (6 documents, 179 citations) and University College London (UCL) (4 documents, 116 citations), both of which play critical roles in interdisciplinary AI research. The presence of the National Taiwan University of Science and Technology, Lingnan University, and Beijing Normal University demonstrates the global scope of AI-related research in English education. These institutions are leading research hubs for AI applications in language learning and pedagogical development.

Table 5
Top 10 Most Cited Institutions

Rank	Organisation	Documents	Citations
1	Education University of Hong Kong	12	188
2	Chinese University of Hong Kong	11	192
3	Hong Kong Polytechnic University	6	15
4	Nanyang Technological University	6	179
5	Beijing Normal University	4	49
6	Lingnan University	4	115
7	National Taiwan University of Science and Technology	4	75
8	North China University of Water Resources and Electric Power	4	43
9	Sichuan University	4	9
10	University College London (UCL)	4	116

4.1.5. Regions

Table 6 shows the top ten most cited regions for AI-driven English education research. With 218 publications and 1,546 citations, the People's Republic of China dominates the field. The United States of America (USA) follows with 50 documents and 481 citations, emphasizing its important academic contributions. Taiwan, England, and Iran all have significant research outputs, with Taiwan producing 25 publications and 339 citations, England contributing 25 articles and 300 citations, and Iran adding 13 documents with 256 citations. Other regions, such as India, Singapore, Saudi Arabia, South Korea, and Oman, highlight the global spread of AI research in English education. These regions influence the academic landscape by encouraging international collaboration and advancing AI-driven pedagogical innovations.

Table 6

Top 10 Most Cited Regions

Rank	Regions	Documents	Citations
1	People's Republic of China	218	1546
2	United States of America (USA)	50	481
3	Taiwan In China	25	339
4	England	25	300
5	Islamic Republic of Iran	13	256
6	Republic of India	9	205
7	Republic of Singapore	10	199
8	Kingdom of Saudi Arabia	17	195
9	Republic of Korea	14	162
10	Sultanate of Oman	3	100

4.2. Co-Citation Analysis

This study employed co-citation and co-occurrence analyses to examine the relationships among prominent studies and keywords in AI within English education. Co-citation analysis identifies influential works by calculating how frequently two papers are cited together, which reveals the field's intellectual structure (Merigó et al., 2015). On the other hand, co-occurrence analysis highlights thematic connections and emerging research trends by analyzing keyword frequency within documents (Van Eck & Waltman, 2017). By integrating these approaches, this study provided a systematic and complementary overview of how AI is being researched and applied in English education. Although our primary

focus is on English education, the insights garnered extend to broader language education contexts, offering generalizable findings across various linguistic settings.

Table 7 ranks these studies by citation count, covering themes like AI-driven language teaching, generative AI tools in pedagogy, AI ethics, and policy development. It illustrated the major research trends and showed how scholars are addressing AI integration, guiding future research in AI-enhanced English education. The top ten articles on AI's application in English education in this table demonstrated the growing role of AI in educational settings, offering a multidisciplinary understanding of the field. Key theoretical, empirical, and practical contributions to the conversation are highlighted in these works, illustrating both the challenges and possibilities of incorporating AI technologies into educational frameworks.

Table 7
Co-citations (Top 10 Articles)

Rank	Authors	Documents	Citations	Total Link Strength
1	Kohnke et al.(2023)	ChatGPT for language teaching and learning	31	140
2	Kasneci et al.(2023)	ChatGPT for good? On opportunities and challenges of large language models for education.	29	136
3	Yan (2023)	Impact of ChatGPT on learners in a L2 writing practicum: An exploratory investigation	22	134
4	Huang et al.(2022)	Chatbots for language learning–Are they really useful? A systematic review of chatbot-supported language learning	18	99
5	Hwang et al.(2020)	Vision, challenges, roles and research issues of Artificial Intelligence in Education	18	60
6	Jeon (2024)	Exploring AI chatbot affordances in the EFL classroom: Young learners' experiences and perspectives	18	87
7	Braun & Clarke (2021)	One size fits all? What counts as quality practice in (reflexive) thematic analysis.	17	86
8	Fathi et al.(2024)	Improving EFL learners' speaking skills and willingness to communicate via artificial intelligence-mediated interactions	17	109
9	Tlili et al.(2023)	What if the devil is my guardian angel:	17	100

Rank	Authors	Documents	Citations	Total Link Strength
10	Huang et al.(2023b)	ChatGPT as a case study of using chatbots in education Trends, research issues and applications of artificial intelligence in language education	17	91

The co-citation analysis identifies several influential studies that form the knowledge base of research on artificial intelligence in English language education. Highly cited works by Kohnke et al. (2023) and Kasneci et al. (2023) discuss how ChatGPT and large language models (LLMs) are used in language teaching, highlighting both their instructional value and related ethical concerns. Yan (2023) provides empirical evidence showing that ChatGPT can support second language writing and improve learners' writing performance. Huang et al. (2022) review research on chatbot-supported language learning and summarize key findings and research trends in this area. From a broader perspective, Hwang et al. (2020) outline the main roles, challenges, and future directions of artificial intelligence in education. These studies establish a solid foundation for current research on AI-enhanced English language education.

4.2.1. Co-Citation analysis by clusters

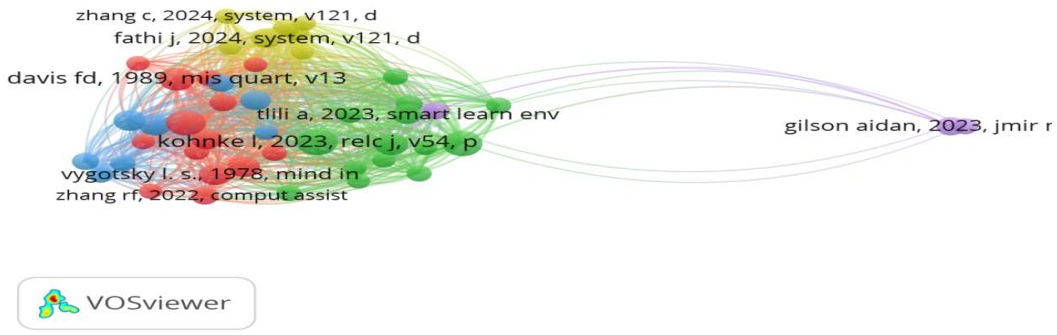
Based on data retrieved from the WoS database, VOSviewer was used for co-citation clustering. The Leiden algorithm was employed, with a minimum co-citation threshold of 46 to ensure meaningful grouping. Each cluster was derived from keyword co-occurrence and representative publications within the cluster. Figure 3 depicts co-citation relationships, which show how studies were linked based on shared citations. Table 8 divides key research clusters on AI in education based on co-citation analysis into four thematic groups: AI foundations, ChatGPT and AI-powered learning, AI chatbots, and digital assistants in EFL learning, and AI-driven engagement and communication in EFL learning. These clusters shed light on the field's intellectual framework and highlighted key research areas such as AI-assisted language learning, ChatGPT"s impact, AI policy and theoretical development, and AI's ethical implications in education. This broad perspective enables a better understanding of major research trends, intellectual connections, and collaboration networks in the field. This method of structuring research enables

the identification of knowledge gaps and areas requiring further investigation.

Based on these findings, Cluster 1 researches the theoretical foundations of AI applications in English language education. Huang et al. (2023a), Zhang and Zou (2022), and Chen et al. (2020a) are among the most representative publications in this cluster. These studies examine the opportunities, challenges, and applications of AI in language education, focusing on its potential to improve both teaching and learning outcomes. Huang et al. (2023a), for example, provide a comprehensive overview of AI trends, focusing on areas where AI could transform language education, such as personalized learning and adaptive learning systems. This cluster emphasizes the importance of ethical considerations when implementing AI, particularly in terms of data privacy, bias mitigation, and accessibility. Related studies address the challenges of incorporating AI into English education, with Gayed et al. (2022) offering applied perspectives on AI-supported language learning. Additional research focuses on the motivational and cognitive dynamics of AI in language learning. Divekar et al. (2022) discuss how AI, in conjunction with extended reality, supports foreign language acquisition and promotes learner engagement. The studies within this cluster lay the theoretical groundwork for understanding AI's transformative potential in education while addressing barriers to adoption. This cluster points out that for AI to effectively drive educational change, there must be active involvement from educators and institutions, alongside the integration of AI tools with pedagogical innovations.

Figure 3

Co-citations Analysis (VOSviewer Visualisation)



Cluster 2 analyzes the influence of ChatGPT and other generative AI

technologies on education. The studies in this cluster highlight generative AI's novel potential for reshaping traditional teaching strategies, particularly personalized learning and adaptive pedagogy. Kohnke et al. (2023) and Kasneci et al. (2023) investigate how AI tools can improve teaching methods and student engagement, whereas Tlili et al. (2023) and Baidoo-Anu and Ansah (2023) focus on the ethical challenges and policy gaps in AI education. This cluster emphasizes the importance of ethical frameworks and policy regulations to guide AI's responsible use in education, ensuring personalized learning while protecting against issues such as algorithmic bias and misuse. Furthermore, research in this cluster demonstrates the significance of aligning policy development with technological innovations in order to foster a sustainable, inclusive AI-driven educational environment.

Cluster 3 investigates the use of AI chatbots and digital assistants in EFL education. Representative studies include Huang et al. (2022) and Jeon (2024), who examine how AI chatbots like ChatGPT act as conversational partners to enhance language practice and reduce speaking anxiety. This cluster focuses on how AI tools can make language learning more interactive, personalized, and emotionally supportive. According to studies, AI platforms such as ChatGPT provide continuous language practice while also fostering emotional engagement and confidence. These studies support AI's transformative power by demonstrating how technological tools can help students overcome psychological barriers, such as anxiety, and engage in meaningful communication. Through emotionally intelligent AI that adapts to learners' needs, this cluster demonstrates how AI can personalize learning experiences and support both academic and emotional growth in EFL classrooms.

Cluster 4 focuses on how AI tools can drive engagement and communication in EFL classrooms. Fathi et al. (2024) and Wang and Xue (2024) investigated how AI tools improve learners' willingness to communicate and academic engagement. This cluster emphasizes the importance of developing interactive AI systems that encourage active participation and foster an empowering environment for students. AI tools such as ChatGPT not only help with language development but also promote academic engagement by encouraging students to participate actively in their education. Educator training and AI literacy are critical components of this cluster because both students and instructors require the necessary skills to effectively engage with AI technologies. This cluster suggests that AI can help

educators create a more inclusive and interactive learning environment, one that actively engages students in their language learning journey while providing the tools to overcome learning barriers.

Table 8

Co-Citation Cluster on AI in English Education

Cluster No and Colour	Cluster Labels	No. of Articles	Representative Publications
Cluster 1 (Red)	AI in English Language Education	14	Huang et al. (2023a); Zhang, R., & Zou, D. (2022); Gayed et al. (2022); Chen et al. (2020a); Chen et al. (2020b); Divekar et al. (2022) ;Huang et al. (2023b)
Cluster 2 (Green)	ChatGPT and AI-Powered Learning	14	Kohnke et al. (2023); Kasneci et al. (2023); Yan (2023); Tlili et al. (2023); Farrokhnia et al. (2024); Mizumoto & Eguchi (2023), Su et al. (2023); Baidoo-Anu & Ansah (2023)
Cluster 3 (Blue)	AI Chatbots and Digital Assistants in EFL Learning	8	Huang et al. (2022); Jeon (2024); Tai & Chen (2023) ; Liu & Ma (2024)
Cluster 4 (Yellow)	AI-Driven Engagement and Communication in EFL Learning	7	Fathi et al. (2024); Wang & Xue (2024); Gao et al. (2024)

The co-citation analysis highlights the interconnected nature of AI research in English language education, revealing how different clusters contribute to a comprehensive understanding of AI's role in transforming education. Cluster 1 lays the theoretical foundations for AI's integration into education, while Cluster 2 explores the innovative impact of ChatGPT and generative AI tools on teaching and learning, with an emphasis on ethical implications and policy frameworks. Cluster 3 illustrates how AI chatbots assist with personalized learning and emotional engagement, while Cluster 4 focuses on how AI can boost academic engagement and communication skills in EFL classrooms. Together, these clusters demonstrate AI's potential to transform language education through offering innovative teaching strategies, addressing ethical concerns, and promoting cognitive and emotional development.

4.3. Co-Occurrence Analysis

Although the co-citation analysis depicted the intellectual landscape of AI in English education, the co-occurrence analysis identified key thematic trends through keyword relationships. This approach offers a complementary viewpoint, linking the theoretical foundations established in co-citation analysis to the evolving research trends highlighted by co-occurrence analysis. By examining how frequently key terms appear together, this study uncovers dominant research focuses, interdisciplinary connections, and emerging topics that shape the discourse on AI in English education. The threshold for inclusion in this analysis was set at 49, with a minimum occurrence of seven keywords.

Table 9 displays the results of a co-occurrence analysis of AI-related keywords in English education, emphasizing key research trends and connections between important concepts in the field. The analysis revealed essential directions in AI in English education, with a total of 1,610 keywords and a threshold of 49 occurrences. The focus was on terms that appeared at least seven times, illustrating the relationships between critical themes and scholarly interests. The analysis identified 493 links, with a total link strength of 999, emphasizing how interconnected these keywords are, which highlights the depth and integration of research in this developing academic domain. The term "total link strength" refers to the extent to which keywords are linked based on their co-occurrence in the literature. A higher link strength indicates a more robust relationship, which assists in identifying significant study trends and areas of overlap in AI English education. Table 9 also includes the top 15 keywords for AI education. Terms such as "artificial intelligence" and "generative AI" highlight the growing role of AI technologies in the educational landscape, whereas "higher education" and "students" emphasize the importance of these advancements. Keywords such as "acceptance" and "model" refer to ongoing discussions about the challenges and strategies associated with AI adoption and implementation.

Table 9

Top 15 co-occurring keywords

Rank	Keyword	Occurrences	Total Link Strength
1	Artificial Intelligence	117	236
2	Chatgpt	55	94
3	English	45	143
4	Education	43	103

Rank	Keyword	Occurrences	Total Link Strength
5	Artificial-intelligence	25	63
6	Students	25	87
7	Generative AI	21	33
8	AI	18	34
9	Language	17	49
10	Model	16	38
11	Technology	16	52
12	Artificial Intelligence (AI)	15	23
13	Impact	15	39
14	Machine Learning	15	30
15	Higher Education	14	27

The most frequently mentioned keyword, "artificial intelligence," appeared 117 times, for a total link strength of 236. This suggests that current English education research is heavily focused on the role of AI. Notable studies, such as those by Chen et al. (2020a) and Sun et al. (2021) have examined the application of AI in educational contexts, highlighting its transformative potential. The analysis also revealed other frequently employed terms, such as "education" (43 occurrences) and "ChatGPT" (55 occurrences). The keywords signify a growing interest in AI-driven tools, particularly in personalized learning and real-time feedback systems, which are critical research areas (Song & Song, 2023; Huang et al., 2023a).

The term "higher education," appearing 14 times with a cumulative link strength of 27, indicates a substantial emphasis on the impact of AI on learning environments, especially in higher education institutions. As AI technologies are progressively incorporated into educational environments, they provide novel opportunities for individualized learning, data-informed insights, and improved student engagement. Research investigating AI's effect on academic performance and pedagogical frameworks, such as that conducted by Wang et al. (2023), has illustrated the substantial effect AI can have on improving educational outcomes. These studies demonstrate that AI tools improve learning processes and provide educators with resources to tailor teaching methods to individual student requirements.

In addition, keywords such as "technology," "students," and "language" emphasize how AI can be leveraged to cater to diverse learning needs. Terms like "impact" (15 occurrences) and "machine learning" (15 occurrences) suggest a growing academic interest in the ethical implications and technical applications of

AI technologies in education (Fathi et al., 2024). The ongoing exploration of "models" and "acceptance" highlights ongoing research on AI system adoption, with a focus on user engagement and AI-driven improvements to the educational experience (Mohamed, 2024). The findings from Table 9 and the co-occurrence analysis demonstrate the interconnectedness of key AI topics in English education. These insights assist in determining where current research is focused and highlighting areas that may require further investigation, such as the ethical challenges of AI implementation and its long-term impact on both learners and educators.

4.3.1. Co-Occurrence analysis by clusters

Figure 4 depicts the interconnectedness of keywords from academic literature, highlighting their frequency and relationships. This clustering identifies key research areas, such as AI applications in education, language learning, and ChatGPT's role in improving educational outcomes. The analysis emphasizes the growing emphasis on AI's impact on EFL teaching, student engagement, and technology integration in educational settings. By mapping these relationships, Table 10 offers a structured summary of current AI-driven education research trends and themes. The identified clusters reveal a wide range of thematic focuses, including the use of AI to improve English language learning, performance evaluation, and AI-based feedback systems. These findings offer a comprehensive picture of how academic research is adapting to the changing demands of AI in educational settings.

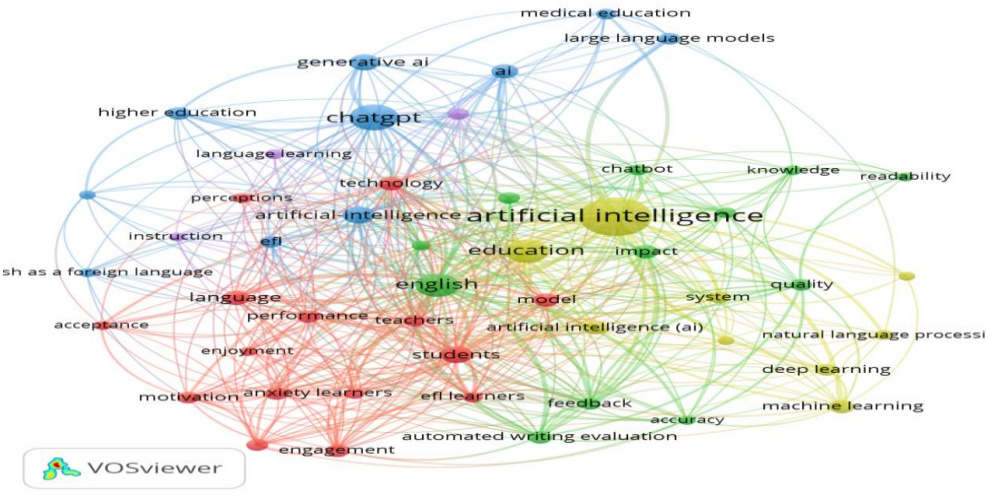
Cluster 1, which included 15 keywords, investigated the role of AI in improving EFL learning, with a focus on TAM and its relationship to learners' psychological responses. The terms "Acceptance," "Technology," "EFL learners," "Achievement," "Motivation," "Engagement," "Performance," and "Anxiety" indicate a strong emphasis on how learners' attitudes toward AI tools influence their academic success and psychological well-being. Representative works, such as those by Sun et al. (2021) and Huang et al. (2023b) demonstrated how AI tools such as ChatGPT can influence student engagement, motivation, and anxiety levels, ultimately improving academic performance. These studies emphasize the importance of understanding how perceived ease of use and perceived usefulness of AI technologies influence students' acceptance of these tools, as well as how this

acceptance correlates with better learning outcomes. Furthermore, studies have demonstrated that employing AI tools diminishes learning anxiety and boosts motivation, making language learning more engaging and effective.

Cluster 2 focuses on the use of AI to assist in writing and feedback in educational settings, with 16 keywords. Keywords like "Accuracy," "Automated Writing," "Evaluation," "Chatbot," "Feedback," "Technology Acceptance," and "Quality" indicate that this cluster is concerned with how AI tools can improve writing accuracy, provide real-time feedback, and improve student work quality. Yan (2023) and Song & Song (2023) discovered that AI-powered writing assistants, like ChatGPT, provide immediate, personalized feedback on writing tasks. Yan (2023) investigates the effects of ChatGPT in an L2 writing practicum, focusing on how it improves grammar, structure, and overall writing ability. Similarly, Song and Song (2023) assess the efficacy of ChatGPT in AI-assisted language learning for EFL students, focusing on the ability to improve academic writing skills and student motivation. The use of AI-based feedback systems encourages a more self-reflective learning process because students can constantly revise and refine their writing based on AI suggestions. The cluster also reflects the importance of technology acceptance, as students' willingness to adopt and integrate AI tools has a significant impact on their ability to improve their writing.

Figure 4

Co-Occurrence Analysis of AI in English Education (VOSviewer Visualisation)



Cluster 3, which focuses on the use of generative AI technologies like ChatGPT in EFL learning environments, includes ten keywords. The keywords "AI," "EFL," "Generative AI," "Large Language Models," and "ChatGPT" pertain to the application of sophisticated language models to provide interactive and tailored learning experiences for EFL students. Generative AI tools have been shown to improve students' language acquisition by providing real-time conversational practice, translations, personalized exercises, and grammar correction. As Fathi et al. (2024) and Kohnke et al. (2023) point out, these tools create an interactive environment in which students can engage in meaningful dialogues and practice their language skills independently. This cluster focuses on the growing role of generative AI in transforming EFL classrooms by making learning more dynamic and tailored to individual needs.

Cluster 4, featuring 9 keywords, concentrates on the broader applications of AI technologies in English language education, including deep learning and Natural Language Processing (NLP). Key terms like "Artificial Intelligence," "Deep Learning," "English Instruction," "Educational Technology," and "Natural Language Processing" refer to the usage of AI in language education for data analysis, personalized learning, and the improvement of teaching methodologies. Chen et al. (2020b) investigated how AI-powered tools improve language teaching by enabling speech recognition, automated translation, and personalized learning content. Deep learning and NLP enable AI systems to understand and generate natural language, giving educators new tools to improve their teaching methods and better meet the diverse needs of students (Gayed et al., 2022). This cluster highlights AI's transformative potential for improving the overall quality and efficiency of English language education.

These clusters indicate a growing body of research on the incorporation of AI into language learning environments, emphasizing the importance of both technological innovation and pedagogical approaches. While the findings are encouraging, more research on AI's long-term effectiveness, ethical concerns, and teacher readiness is required. Future research should seek to fill these gaps and provide a more comprehensive understanding of how AI can be best integrated into EFL education.

Table 10
Co-Occurrence Analysis of Keywords on AI in English Education

Cluster No and Colour	Cluster Label	Number of Keywords	Representative Keywords
1 (Red)	AI-Enhanced EFL Learning: TAM and PsychologicalResponses	15	"Technology" "Acceptance" "EFL learners" "Achievement" "Performance" "Motivation" "Engagement" "Anxiety"
2 (Green)	AI-Assisted Writing and Feedback	12	"Accuracy" "Automated Writing" "Evaluation" "Chatbot" "Feedback" "Technology Acceptance" "Quality"
3 (Blue)	Generative AI in EFL Learning	10	"Large Language Models""AI""EFL" "Generative AI" "ChatGPT"
4 (Yellow)	AI-Powered English Language Education	9	"Artificial Intelligence" "Deep Learning" "Education Technology" "English Teaching" "Natural Language Processing"

5. Discussion

This study's findings, which included a bibliometric analysis of the integration of AI in English education, have far-reaching implications for technological challenges, a lack of ethical frameworks, insufficient teacher training, and a lack of interdisciplinary collaboration. These findings facilitate future research on AI in English education, specifically regarding the effective application of AI technologies, longitudinal assessment, ethical considerations, policy formulation, and teacher assistance. The findings are discussed in accordance with the study's objectives and in comparison with prior research to determine how they align or diverge from existing literature. This enables both academia and educational practitioners to identify current research gaps and advance educational innovation.

Unlike earlier reviews of AI in English education (Huang et al., 2023a), this study adopts a more structured and data-driven approach by integrating performance analysis, co-citation analysis, and co-occurrence mapping. Huang et al. (2023b) wrote a story-like summary of research topics and how AI can be used in language education. However, their analysis was devoid of bibliometric synthesis and clustering insights. By identifying unique thematic clusters (including generative AI, AI chatbots, and ethical frameworks), our research goes beyond this, thereby presenting a systematic map of intellectual connections and research trajectories. In the same vein, Kasneci et al. (2023) examined the potential and risks

of ChatGPT; however, their analysis was conceptual rather than quantitative. This study adds to their work by visualizing how citation patterns reflect increased interest in ethical issues and pedagogical integration. Through this comparative lens, the current review not only confirms prior findings, but also reveals previously unexplored areas, such as interdisciplinary collaboration and a lack of teacher-focused AI training, adding a new bibliometric dimension to the existing body of literature.

5.1. Theoretical Implications

This study makes significant contributions to theoretical frameworks by investigating the complex relationship between user acceptance, ethical considerations, and educational outcomes. We extend TAM (Liu & Ma, 2024) to investigate AI adoption in English education by basing it on views of ease of use and usefulness, so impacting user acceptance of new technologies. We contend that AI integration is a continuous process influenced not only by individual user perceptions, but also by institutional support, ethical considerations, and interdisciplinary collaboration (Huang et al., 2023a).

Our findings indicate that the interaction of technological capabilities and ethical frameworks governing its use influences AI adoption in education. This is consistent with the findings of Dwivedi et al. (2019), who emphasize the need for a broader adoption framework that goes beyond TAM and includes factors like ethics and institutional support, as well as more recent multidisciplinary discussions on generative AI governance and responsible adoption (Dwivedi et al., 2023). By stressing the critical need for ethical issues in the deployment of AI in educational environments, especially with regard to data privacy, algorithmic bias, and fair access, this study also broadens present theoretical models (Song & Song, 2023).

Furthermore, the co-citation and co-occurrence analyses reveal that AI research in English education is disjointed, demonstrating limited theoretical cohesion between AI technology and pedagogical approaches. This disparity indicates the necessity for a cohesive theoretical framework that integrates pedagogical strategies, user engagement, and technological efficacy (Wang et al., 2023). We contend that AI's role in language education is not passive; it actively transforms pedagogical practices, requiring a shift in instructional strategies and student assessment models.

5.2. Practical Implications

Based on our findings, we recommend that educational institutions implement structured AI training programs to promote the use of AI technologies. Universities ought to establish AI literacy programs for faculty and students, incorporating user-focused training modules on ethical concerns such as data privacy and responsible AI utilization (Nazari et al., 2021; Su et al., 2023). The training programs must be categorized into three tiers:

- Basic Level: An introduction to AI applications, with a focus on ethical considerations and data privacy.
- Intermediate Level: Discover how AI tools like ChatGPT can enhance academic performance.
- Higher-level AI integration projects involve collaboration between students and faculty to improve educational systems.

In addition to training, interdisciplinary collaboration is required. AI-integrated labs should be established to promote collaboration between language educators, computational linguists, and computer scientists. This approach is consistent with prior research, which discovered that interdisciplinary collaboration bridges the gap between technological advancement and pedagogical integration (Chen et al., 2020a). By encouraging this collaboration, educational institutions can ensure that AI is implemented effectively and ethically.

Moreover, the study emphasizes the importance of personalized academic support. AI-driven tools like Intelligent Tutoring Systems (ITS) can provide tailored exercises based on students' weaknesses, such as improving post-editing skills and reducing reliance on AI-generated content (Jeon, 2024; Fathi et al., 2024). These tools can track student progress and provide real-time feedback, permitting educators to adjust their teaching strategies and increase student engagement.

To ensure that AI is used ethically and responsibly, we recommend collaboration between universities and professional translation or language organizations. By collaborating, they can create AI tools that follow industry best practices, ensuring that students are prepared for both academic and real-world AI applications in language education (Gayed et al., 2022). Future research could explore specific models of university–industry collaboration in AI-driven language education, or

investigate the long-term impact of such partnerships on translation competence development.

5.3. Limitations and Delimitations

Although this study provides useful insights into AI adoption in English education, it is critical to recognize a number of limitations. The analysis was initially based on a specific database (Web of Science), which may have excluded relevant studies that were not indexed there, limiting the scope of the results. The study's focus on 2020-2024 limits its ability to detect long-term trends in AI adoption. The dependence on bibliometric methods resulted in the exclusion of qualitative insights relevant to the pedagogical, ethical, and psychological effects of AI. Future research could improve comprehension by integrating qualitative methods, such as interviews or case studies. Moreover, the generalizability of the results may be influenced by regional differences in educational systems and technological infrastructures. Divergences in institutional policies and practices across regions may influence AI adoption, necessitating further investigation in varied contexts. The study ultimately neglects to consider potential biases in the examined literature, which may affect the overall interpretation of AI's role in education. Future research should look at a broader range of sources, use mixed-methods approaches, and investigate AI's impact in a variety of educational contexts.

This study is delimited to English-language literature published from 2020 to 2024, specifically examining AI adoption in English education contexts. Only peer-reviewed journal articles indexed in the WoS were included, while conference papers, book chapters, and publications in languages other than English were excluded. The analysis was limited to bibliometric and content-based review methods, excluding empirical validation through interviews or case studies. The delimitations were deliberately established to guarantee methodological consistency and facilitate manageability within the research's scope and timeframe.

6. Conclusion

6.1. Summary of Key Findings

This study performs a bibliometric analysis of AI in English education, emphasizing significant research trends, intellectual underpinnings, and thematic

interrelations through co-citation and co-occurrence analyses. The results reveal four primary research clusters: AI-assisted language acquisition, ChatGPT in pedagogy, AI chatbots for EFL learners, and AI-driven student engagement. Co-citation analysis identifies influential studies that shape the field, whereas co-occurrence analysis identifies recurring themes like technology acceptance, ethics, and personalized learning. The findings add to theoretical frameworks by extending TAM, emphasizing the importance of institutional support, ethics, and interdisciplinary collaboration in AI adoption. AI technologies, including ChatGPT and intelligent tutoring systems, present novel opportunities for personalized education, enhancing engagement and improving results. Moreover, guaranteeing equitable access to AI tools advances Sustainable Development Goal 10 (Reduced Inequalities) by diminishing educational disparities among various linguistic and socioeconomic groups.

6.2. Suggestions for Future Research

Future research should explore long-term AI adoption, regional variations, and ethical challenges–such as algorithmic bias, data privacy, and transparency–to align with global education sustainability goals and promote AI's inclusive and effective implementation in English education. Comparative analyses of various educational systems and cultural contexts may provide insights into localized implementation difficulties. Moreover, enhancing interdisciplinary collaborations among educators, technologists, and policymakers will be crucial in defining AI's role in future educational environments and guaranteeing its integration is both pedagogically sound and ethically responsible.

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