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Artificial Intelligence in EFL Education in China: A Systematic Review of Trends, Gaps, and Future Directions (2015-2024)

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Abstract

This study conducts a systematic review of artificial intelligence in English as a Foreign Language teaching and learning in China from 2015 to 2024 based on 56 articles selected from Scopus, ScienceDirect, ERIC, and CNKI databases, highlighting emerging trends, unresolved gaps, and possible avenues for future research. The findings reveal that AI in EFL education in China is at an early yet fast-developing stage. Research designs are dominated by experimental studies, system or model design, and empirical studies, with the mixed method being the most common, while the qualitative method is neglected in experimental research. AI systems and platforms like ChatGPT and Pigai are widely discussed, but AI algorithms receive limited attention. Higher education and university students are the focus, whereas K12 participants, adult learners, policymakers, AI developers, and administrators are rarely involved. The most discussed language skills are speaking and writing. Language acquisition and affective or psychological states are the most studied learning outcomes, while contemporary competencies remain under-researched. AI's role in enhancing English skills is well-documented, but its potential in administration, intelligent tutoring, and adaptation and personalization remains underexplored. The review offers an up-to-date landscape with valuable insights for academics, teachers, decision-makers, and AI technologists.

Keywords: *Artificial Intelligence, EFL Education, China, Systematic Review*

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Introduction¹

The term artificial intelligence was first officially employed in 1956, marking the beginning of a new field (Russell & Norvig, 2010). In his 1950 paper, "Computing Machinery and Intelligence," Alan Turing initially expressed the hopeful notion of "thinking machines," forecasting the developments and progress of artificial intelligence in this landmark work. In 2016, worldwide interest in AI research escalated after AlphaGo's extraordinary victory over the reigning world Go champion, Lee Sedol (Simonite, 2016). AI's widespread impact across socioeconomic domains, especially education, influences educational methodologies, strategies, and tools, which have been widely discussed in recent years. Artificial Intelligence in education is called AIED (Luckin et al., 2016). Educational AI was projected to grow by 43% between 2018 and 2022 (Becker et al., 2018). The application of artificial intelligence in education offers the potential for a "more personalized, flexible, inclusive, and engaging" learning experience and a more advanced educational environment (Luckin et al., 2016, p. 11). Several studies indicate that AI can enhance language education (Gao, 2021; Klimova et al., 2022; Kuo, 2020; Pikhart, 2021). As Kuo (2020) stated, the integration of AI technologies, including face and image recognition and adaptive learning, has initiated transformative changes in education, enhancing student learning outcomes and teaching efficiency. To date, numerous extensive reviews exist on AI in education, including AI in higher education (Zawacki-Richter et al., 2019), the assessment of machine learning (Zhai et al., 2020), AI in deep learning (Guan et al., 2020), AI in e-learning (Tang et al., 2023), and AI in language education (Yang & Kyun, 2022). According to the review by Yang and Kyun (2022) on AI in language teaching and learning, 68.0% of the total is devoted to English, which indicates the predominant focus of English education and the importance of understanding the present landscape of AI in English education.

Several systematic reviews have been conducted on AI in English education in recent years. And the review of AI in English education can be divided into 6 categories: Overall review on trends of AI in English education (Wahyuni et al., 2024), including reviews on AI's role in English education (Ghafar et al., 2023; Yu & Nazir, 2021), and general review (Rahmanto & Indah, 2023; Sharadgah & Sa'di, 2022); impact of AI in English education on learning motivation and achievement (Yang, 2024), learning achievement (Xu & Wang, 2024), and cognitive and motivational impact of AI English language learning (Javaid, 2024); challenges and opportunities of AI in EFL (Al-khreshehm, 2024; Dai & Liu, 2024); review on specific AI technologies such as ChatGPT (Asad et al., 2024; Fitria, 2023), emotional artificial intelligence (Liu et al., 2024); reviews on enhancing specific English skills and competences, interactional and communicative skills (Rusmiyanto et al., 2023; Zhai & Wibowo, 2023), enhancing learners' affective factors (AlTwijri & Alghizzi, 2024), and English academic writing (Raheem et al., 2023); reviews focused on prospective teachers (Peña-Acuña & Durão, 2024), and from teachers' perspectives (Zulkarnain & Yunus, 2023). Jiang (2022) performed a brief review of AI English instruction, emphasizing its transformative effect on English education. Jiang

¹The review is part of the first author's PhD dissertation, which contains a broader review of the integration of artificial intelligence in English as a Foreign Language (EFL) education in China. A related review article based on the same dataset but with distinct research questions and analytical focuses will be submitted to another journal. Both review articles are complementary and distinct in their scope and content.

(2022) highlighted that reviews focusing on AI within the EFL context remain limited. The previous reviews have significantly advanced our understanding of AI in English education. However, previous reviews focus only on specific types of AI technologies, particular teacher groups, the impact of AI on enhancing specific English skills or competencies, and challenges and opportunities of AI in English education. Currently existing reviews have predominantly adopted a micro-perspective on AI in English education, limiting their scope to narrow domains. Therefore, this gap indicates the need for macro-level reviews to provide an overall landscape of AI in English education. Moreover, region-specific reviews on AI in English education are even scarcer.

In recent years, the global EdTech landscape reveals that China is one of the three principal competitors (the US, India, and China) for leadership in the EdTech sector (HolonIQ, 2024). Concerning the proliferation of EdTech startups and the innovation and improvement of more efficient AI-driven EdTech, China is among the top three nations leading the field. The State Council of China released *the New Generation Artificial Intelligence Development Plan* in 2017, which aims to establish a USD 150 billion AI industry. This plan targets making China a global frontrunner in Artificial Intelligence by 2030. Consequently, we recognized the necessity for a targeted systematic review concentrating on the current landscape of AI in EFL education in China. By focusing on China, this study provides a comprehensive understanding of AI in EFL education against the background of a rapidly advancing, policy-driven educational system. Additionally, findings can help stakeholders to improve AI integration strategies, ensuring equal access and pedagogical effectiveness across diverse learning environments. Most importantly, experiences from China can inform global best practices in AI-assisted language learning (AILL).

The review aims to analyze and organize the extensive literature about the integration of artificial intelligence in EFL teaching and learning in China. The paper seeks to identify the trends and gaps in the current research by examining the publication year, research types and methods, AI technologies and tools used, participants, language skills addressed, learning outcomes, and AI's roles in EFL education in China.

Accordingly, this review addresses the research questions as follows:

RQ₁: What are the current trends of applying artificial intelligence applications to EFL teaching and learning in China (2015-2024), focusing on publication years, research methodologies, implemented AI technologies, participants, and targeted language skill domains?

RQ₂: What are the learning outcomes and AI's role in EFL education?

This study employed a Systematic Literature Review approach to examine AI in EFL education in China from 2015 to 2024, utilizing four databases: Scopus, ScienceDirect, ERIC, and CNKI. In total, 1,001,463 articles were identified in the database search. A total of fifty-six articles were ultimately incorporated into the review. The following part elaborates on the methodology.

Methodology

The present study followed the principles of PRISMA proposed by Page et al. (2021). Therefore, this study consists of six phases: Development of inclusion and exclusion criteria,

article selection, article screening and inclusion, data extraction, coding and analysis, and presentation of findings.

Database Search and Search Terms

Based on the guidelines of PRISMA and the research questions of the review, the first author developed the search strategy and search terms, and the second author checked and agreed on them.

Table 1

Searching Keywords

| | Core Searching String Components | Keywords |
|---|----------------------------------|--|
| 1 | AI | "Artificial intelligence", "AI", "machine learning", "deep learning", "intelligent systems", "natural language processing", "人工智能" |
| 2 | EFL | "English as a Foreign Language", "EFL", "language learning", "language teaching", "English language instruction" |
| 3 | Teaching and Learning | "Teaching and learning" "English language instruction" "language learning" OR "language teaching", "英语教学" |
| 4 | Geographic Focus: China | "China", "Chinese" |

Keywords (shown in Table 1) related to AI (e.g., "artificial intelligence", "AI"), EFL (e.g., "English as a foreign language", "EFL"), and China (e.g., "China", "Chinese") are combined with "AND", "OR" to form different search strings. Four databases were searched: ERIC (Education Resources Information Center), ScienceDirect, Scopus, and China National Knowledge Infrastructure (CNKI). The search within the abstract, title, and keywords was undertaken from the 4th of August 2024 to the 11th of September 2024. The search keywords are in English and Chinese, which was considered appropriate as CNKI in domestic China is in Chinese. By the characteristics of each database, the searching strings are different, as shown in Table 2. The search in the ERIC database yielded fewer results after the brief screening of the title and abstract, so more search terms ("machine learning", "deep learning", "intelligent systems", "natural language processing) were added. In ScienceDirect, two searches with different search strings are conducted to search for more articles that can be included. In CNKI, a search limit was applied to ensure only high-quality articles were included, so only articles published in core journals included in Nanjing University's Chinese Social Sciences Citation Index (南核) and Chinese Social Sciences Citation Index (北核) were selected. The details of the searching date and searching strings are shown in Table 2.

Table 2*Searching Recording*

| Data Bases | Searching Date | Searching String |
|--|----------------|--|
| ERIC | 4-Aug-2024 | "Artificial intelligence" OR AI OR "machine learning" OR "deep learning" OR "intelligent systems" OR "educational technology") AND ("English as a Foreign Language" OR EFL OR "language learning" OR "language teaching" OR "English language instruction") AND China OR Chinese |
| ScienceDirect | 4-Aug-2024 | The 1st search: "artificial intelligence" OR AI AND "English as a Foreign Language" OR EFL OR "language learning" OR "language teaching" OR "English language instruction" AND "China" OR "Chinese" The 2 nd search: AI AND English teaching and learning AND China OR Chinese |
| Scopus | 4-Aug-2024 | "Artificial intelligence" OR AI AND "English as a Foreign Language" OR EFL OR "language learning" OR "language teaching" OR "English language instruction" AND "China" OR "Chinese" |
| China National Knowledge Infrastructure (CNKI) | 11-Sep-2024 | 人工智能(artificial intelligence) 英语教学(English teaching and learning) |

Inclusion and Exclusion Criteria

After developing the search string, the authors of the present study designed inclusion and exclusion criteria (see Table 3). Only research that met the following criteria was included.

Table 3*Inclusion and Exclusion Criteria*

| Inclusion Criteria | Exclusion Criteria |
|---|---|
| Published in peer-reviewed journals | Conferences, book series, chapters in books, books, and dissertations |
| Indexed in ERIC (Education Resources Information Center), ScienceDirect, Scopus, China National Knowledge Infrastructure (CNKI) | Not indexed in ERIC (Education Resources Information Center), ScienceDirect, Scopus, China National Knowledge Infrastructure (CNKI) |
| Focus on the use of AI in EFL education in China | Not focused on AI in the EFL education, not in China |
| No systematic reviews | Systematic reviews |
| Written in English and Chinese | Articles in other languages |
| Available in full text | Not available in full text |
| Published between 2015 to July 2024 | Published before 2015 and after 2024 |

Selection and Screening

The methodology for selection and screening in this review adhered to the PRISMA guideline (Page et al., 2021) and was illustrated in Figure 2. A total of 1,001,463 records were identified, 1,001,294 records were removed, and 169 records remained after database screening of the title and abstract by the first author. Then, 169 records were sought for retrieval, and 44 records were not retrieved for the following reasons: full-text unavailable (n=5) in Scopus and duplication removed (n=39) in CNKI. 120 articles were retrieved and downloaded for eligibility assessment. The second author was consulted to ensure that 120 articles were

reasonably selected and met the criteria (see Table 3). Further, the first author screened the full-text articles, and a definitive consensus was reached through discussions and examination of evidence based on the inclusion and exclusion criteria. When ambiguity emerged in the screening and selection process, two authors scrutinized the full versions of relevant publications and decided to include or exclude them. Of the 120 articles, 64 were excluded as they were: not about EFL(n=11), not about AI (n=16), not related to China (n=11), dissertation (n=5), other reasons (n=1), and what should be mentioned was that among the excluded articles, 4 articles selected from Scopus, for some reasons had been retrieved by journal but still can be searched and downloaded from the database and the authors of the present study decided to exclude these articles from the review. One article downloaded from CNKI that failed to open was excluded, and 14 book reviews from CNKI were also excluded. Finally, 56 articles were selected after the selection and screening process (see Figure 1).

The first author of the present review is a native Chinese speaker, and all the articles from CNKI are in Chinese. The first author screened 28 articles from CNKI.

The selection and screening process was conducted manually by two authors of the present review. No technological tools were used. The whole process took four months from August 2024 to December 2024.

Data Coding and Analysis

This review used the coding methodologies of Heift and Schulze (2007), Hung et al. (2018), and Liang et al. (2021) as guidance for coding and analysis. An AI in EFL research review model based on the technology-based learning model for AILEd, advocated by Liang et al. (2021), has been developed (see Figure 2) in this review. The categories, the encoding for each category, and references are illustrated in Table 4.

Figure 1
The PRISMA Diagram

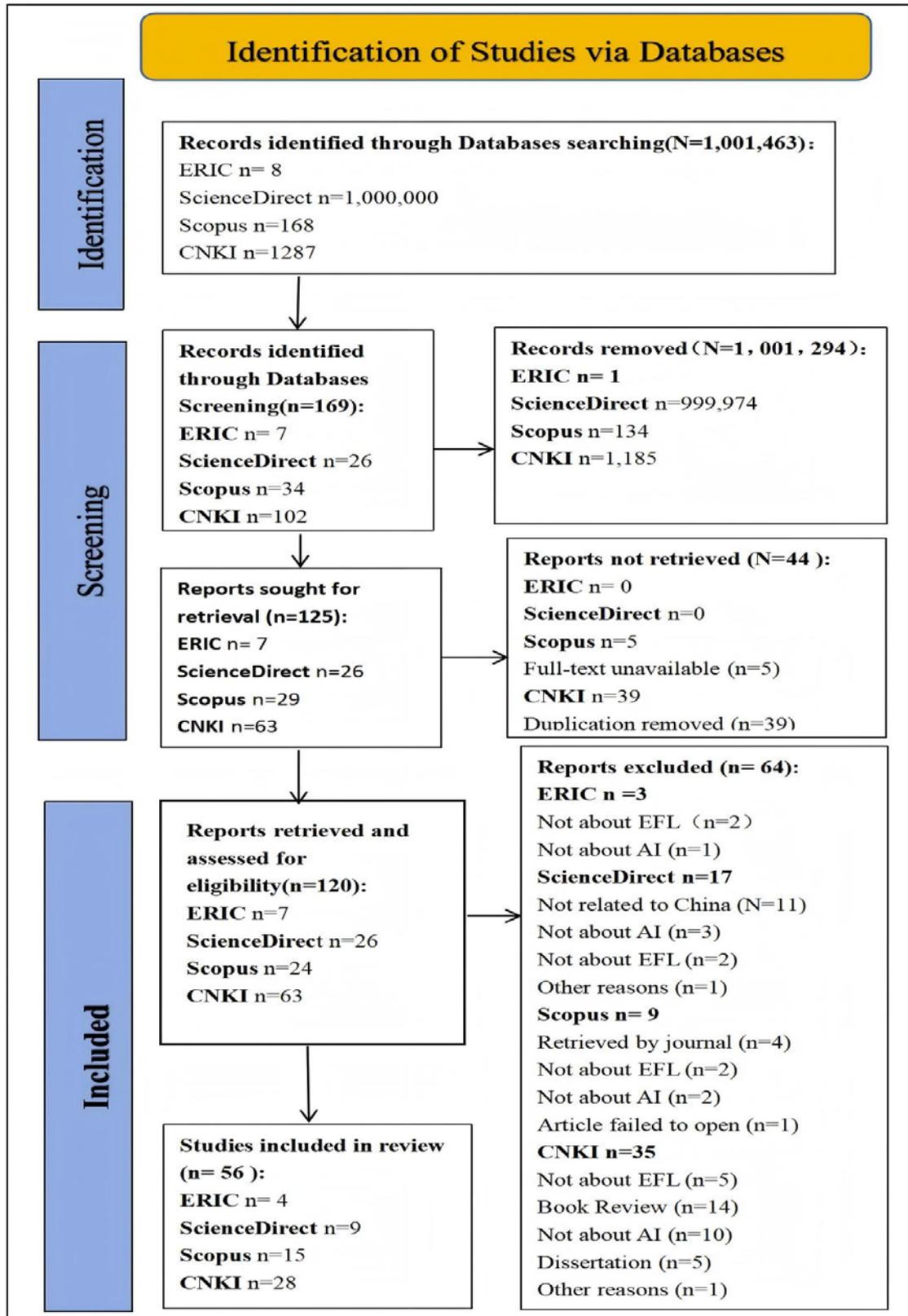


Table 4*Coding Scheme*

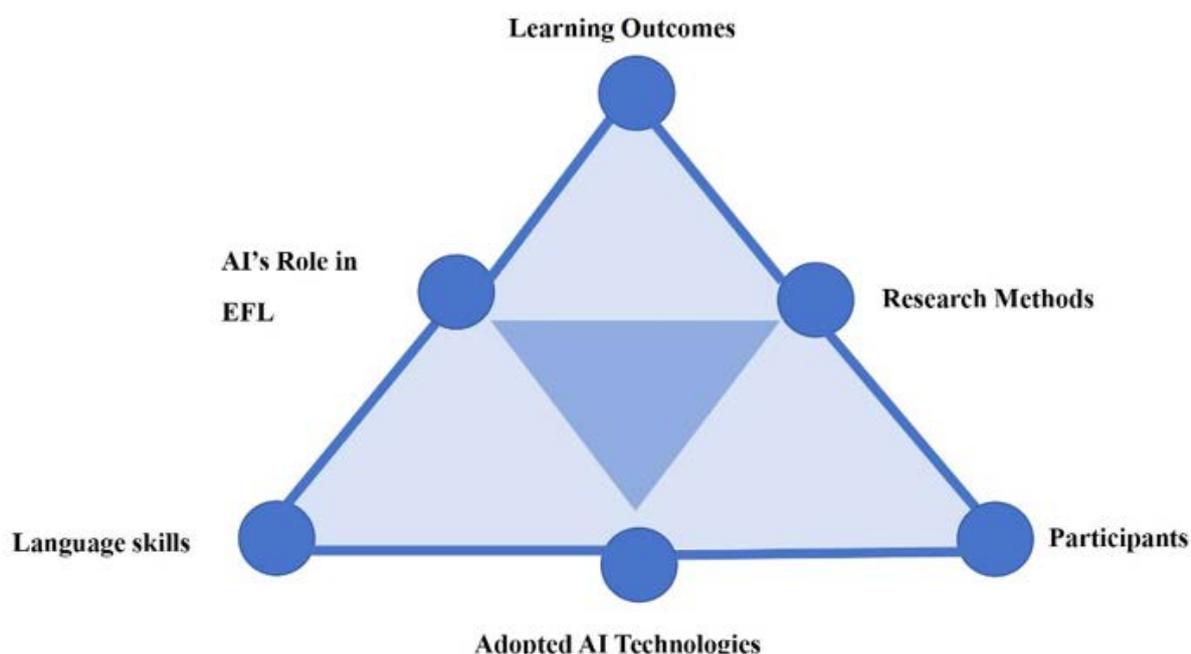
| Categories | Coding | Sub-coding | References |
|---------------------------------|------------------------------|--|--|
| Publication year | Publication year | - | - |
| Research methodologies | Research designs and methods | [A] Empirical Research [A1] Quantitative [A2] Qualitative [A3] Mixed Methods [B] Experimental Research [B1] Quantitative [B2] Qualitative [B3] Mixed Methods [C] Applied Research [D] Conceptual Research or Theoretical Research [E] System, Model or tool Design | Adapted from Liang et al. (2021) Adopted from (Creswell & Creswell, 2017) |
| Implemented AI technologies | AI technologies and tools | [A] AI Algorithms [A1] Machine Learning Algorithms [A2] Deep Learning Models [B] AI Systems and Platforms [B1] Language Teaching and Learning Systems [B2] Speech and Pronunciation Systems [B3] Assessment Systems [B4] Diagnostic and Support Systems [B5] Frameworks for Collaboration [B6] Platforms [C] AI Applications [C1] Interactive Learning Applications [C2] Writing Assistance and Feedback Tools [C3] Engagement and Simulation Tools | Adapted from Heift and Schulze (2007) |
| Participants | Participants | [A] Students [A1] University Students [A2] Secondary School Students [A3] Primary Students [A4] Cross-level Students [A5] Adult Students [A6] Chinese EFL Learners [B] Teachers [B1] Secondary School Teachers [B2] Pre-service English Teacher [B3] University Teachers [B4] University Teachers and Students [C] Educational Administrators [D] AI Developers [E] Policy Makers [F] No human Participants | Developed by the authors of the present study. |
| Targeted language skill domains | Language Skills | Listening, Speaking, Reading, Writing, Vocabulary, Grammar, Pronunciation, Translation, Integrated / Whole language, and N/A | Hung et al. (2018) |
| Learning outcomes | Learning Outcomes | [A] Language Acquisition [A1] Listening [A2] Speaking [A3] Reading [A4] Writing [A5] Vocabulary [A6] Grammar [A7] Pronunciation | Adapted from Liang et al. (2021) |

| | | | |
|--|-----------|---|----------------------------------|
| | | [A8] Translation [A9] Integrated / whole language [B] Knowledge Acquisition [B1] Subject-matter [B2] Culture Learning [B3] Other Knowledge or Content [C] Contemporary Competences [C1] Problem Solving [C2] Critical Thinking [C3] Creativity [C4] Communicative Competence [C5] Other Higher-order Thinking [D] Affective or Psychological States [D1] General Perceptions or Attitudes [D2] Motivation or Engagement [D3] Technology Acceptance or Evaluation [D4] Self-efficacy or Confidence [D5] Cognitive Load [D6] Learner Autonomy [D7] Willingness to Communicate [D8] Other Affective State | |
| AI's role in EFL teaching and learning | AI's Role | [A] Administration in EFL [A1] Admissions and Scheduling [A2] Drop-out Prediction and Retention [A3] Academic Monitoring [B] Intelligent Tutoring Systems (ITS) in EFL [B1] Content Delivery [B2] Strength Diagnosis and Feedback [B3] Learning Resource Management [B4] Collaborative Learning Facilitation [C] Assessment and Evaluation in EFL [C1] Automated Grading [C2] Feedback Generation [C3] Understanding Assessment [C4] Engagement Monitoring [C5] Teacher Evaluation [D] Adaptive Systems and Personalization [D1] Adaptive Content Delivery [D2] Personalized Recommendations [D3] Teacher Support and Design [D4] Individualized Guidance [D5] Knowledge Representation [D6] Adaptive Learning Paths [E]Engagement and Motivation [E1] Motivation Enhancement [E2] Behavioral Analysis [E3] Engagement Enhancement [E4] Interactive Tools [F]English skills [F1] Listening Skills [F2] Speaking Skills and Pronunciation [F3] Reading Skills [F4] Writing Skills [F5] Translation Skill [F6] Vocabulary and Grammar Acquisition [G]Contemporary Competencies Enhancement [G1] Cross-Cultural Competence [G2] Contemporary competencies | Adapted from Liang et al. (2021) |

The coding process was conducted manually by the first author by resorting to the previous studies and adhering to the research aims and questions of the present review. Online meetings were held to solve the difficulties and ambiguity in categorizing, and a final consensus was achieved on the category and encoding of the present review. Data analysis was performed and visualized in WPS Office Excel.

Figure 2

AI in EFL Research Review Model (Adapted from Liang et al. (2021))



Data Extraction

Data from 56 articles were extracted through carefully designed Excel reading notes, which were made based on research aims and coding schemes. The first author extracted the data for the systematic analysis, and the second author reviewed the reading notes and double-checked the data.

For some of the articles in Chinese without English titles, abstracts, and keywords, the first author translated the titles and the extracted data into English. To secure the accuracy of the translation, translation tools such as Google Translate and ChatGPT 4 were resorted to as assistant tools during the translation process.

Results

Publication Years

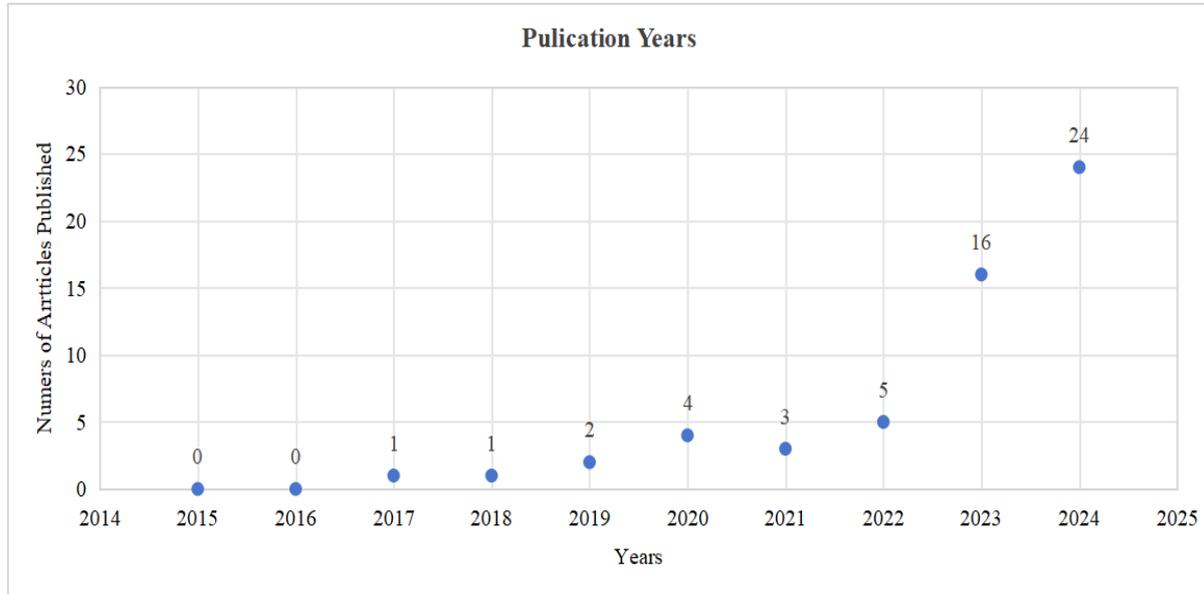
As illustrated in Figure 3, although articles published from 2015 to 2024 were searched and screened, no articles published in 2015 and 2016 were included based on the inclusion and exclusion criteria. From 2017 to 2021, only 11 (19.6%) were published. In contrast, the number of publications published increased significantly beginning in 2022. The number of articles increased from 5 in 2022 to 24 in 2024 (see Figure 3). There are noticeable trends in the publication years:

Slow growth years (2015–2021): Between 2015 and 2021, the number of papers published was low, with a modest increase from 0 in 2015 and 2016 to only 11 from 2017 to 2021.

Rapid development years (2022-2024): A sharp rise in published papers is observed after 2021, starting with 5 articles in 2022 and increasing to 24 by 2024.

Figure 3

Distribution of Articles on Publication Year

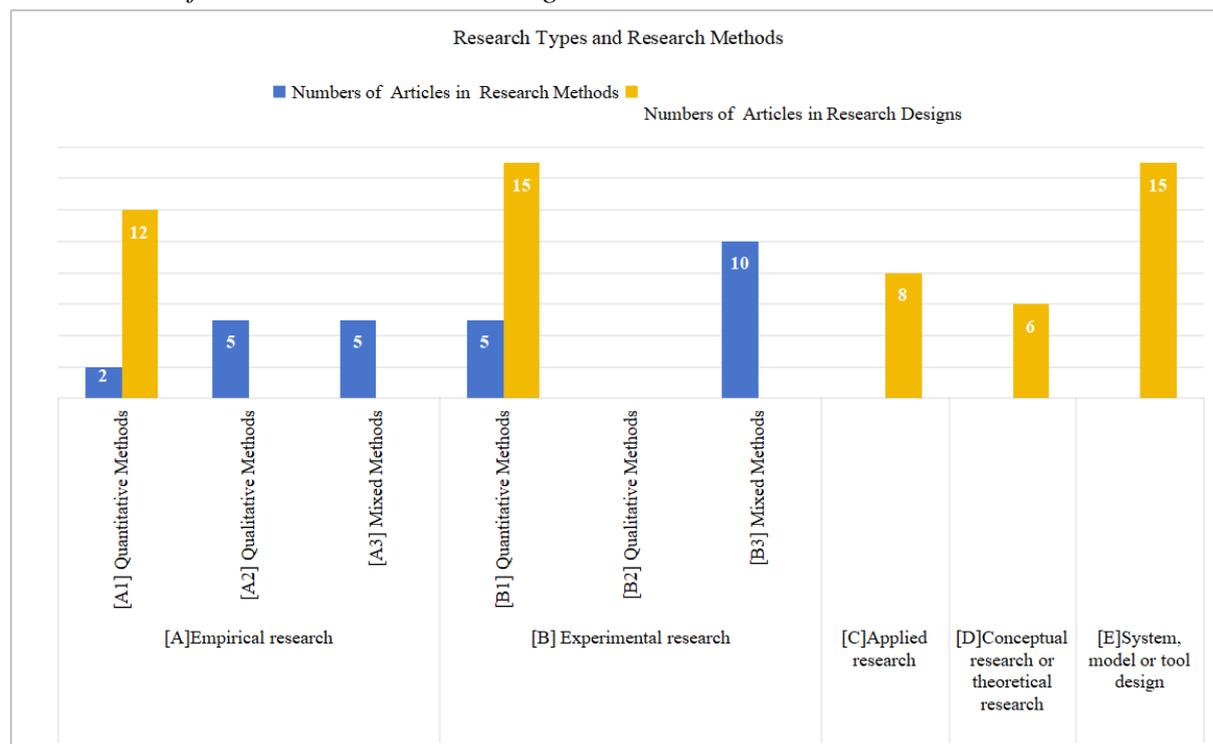


Research Designs and Methods

Figure 4 illustrates the distribution of articles on research designs and research methods. For research designs, Experimental Research and System, Model, or Tool Design are the most common, with 15 articles each, representing 26.8% respectively. This is followed by Empirical Research with 12 articles (21.4%), Applied Research with 8 articles (14.3%), and Conceptual or Theoretical Research comprising 6 articles (10.7%). Based on Creswell and Creswell (2017), the research methodologies are classified as quantitative, qualitative, and mixed methods. As shown in Figure 4, Empirical Research and Experimental Research are sub-categorized into quantitative, qualitative, and mixed methods. Mixed Methods are predominant with 15 articles (26.8%), followed by Quantitative Methods comprising 7 articles (12.5%), and Qualitative Methods are the least presented with 5 articles (8.9%); notably, no Qualitative Methods were employed under Experimental Research.

Figure 4

Distribution of Articles on Research Designs and Research Methods



AI Technologies

39 AI technologies are used or discussed in the 56 reviewed articles. Following is the list of the 39 AI technologies:

[A] AI Algorithms (9 AI technologies)

[A1] Machine Learning Algorithms (6 AI technologies)

Random Forest

Artificial Bee Colony (ABC) Algorithm

Deep Convolutional Neural Network (DCNN)-based evaluation model

Classification and Regression Tree (CART)

Big Data Mining

Statistical Machine Translation (SMT)

[A2] Deep Learning Models (3 AI technologies)

Chatbots powered by large language models (LLMs)

Neural Machine Translation (NMT)

YOLOv7 model

[B] AI systems and platforms (19 AI technologies)

[B1] Language Teaching and Learning Systems (7 AI technologies)

AI-powered English language learning tools

Oral English Training System Based on Big Data Content Recommendation Algorithm

Adaptive Learning System

AI-aided teaching system

Smart Adaptive Learning System (SALS) for College English using Deep Knowledge Tracing (DKT)

Neural Network-Based Online Teaching Interactive System

Artificial intelligence technology "Clips"

[B2] Speech and Pronunciation Systems (3 AI technologies)

Automatic Speech Recognition (ASR)

Artificial Intelligence Speech Evaluation Programs with Automatic Feedback

EAP Talk (speech evaluation system)

[B3] Assessment Systems (2 AI technologies)

Automated assessment platform

Automatic scoring system for interpreting

[B4] Diagnostic and Support Systems (2 AI technologies)

AI-driven database management and operational systems

Intelligent Diagnostic Systems

[B5] Frameworks for Collaboration (1 AI technology)

Human-Machine Collaboration Framework

[B6] Platforms (4 AI technologies)

Grammarly platform

WeChat and its Mini Program

AI Chinese Platform (<https://chat.tjtn.en/index.html>)

AI-powered Annotation Platform

[C]AI applications (11 AI technologies)

[C1] Interactive Learning Applications (6 AI technologies)

ChatGPT

Generative AI

Bing Chat

Duolingo application

Reading Bot (a GenAI-based chatbot)

AI apps

[C2] Writing Assistance and Feedback Tools (3 AI technologies)

iWrite: Writing teaching and evaluating system

Natural Language Processing (NLP)

The AWE system: Pigai

[C3] Engagement and Simulation Tools (2 AI technologies)

Virtual Reality (VR) technology

English Simulation Modules

As shown in Figure 5, 12 articles (21.4%) did not specify AI technologies. The top three AI technologies discussed are ChatGPT (10 articles, 17.8%) and The AWE system: Pigai (3 articles, 5.4%), followed by Virtual Reality (VR) and Natural Language Processing (NLP) (2 articles each, 3.6% each).

Figure 5

Distribution of Articles on AI Technologies and Tools

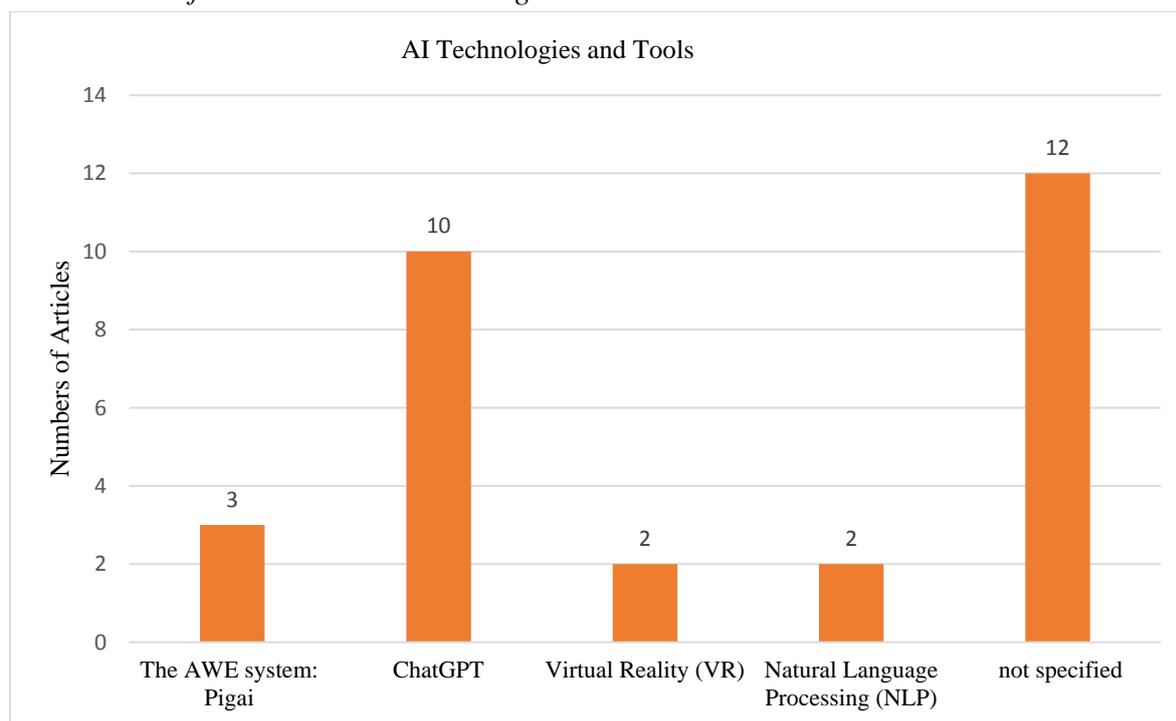
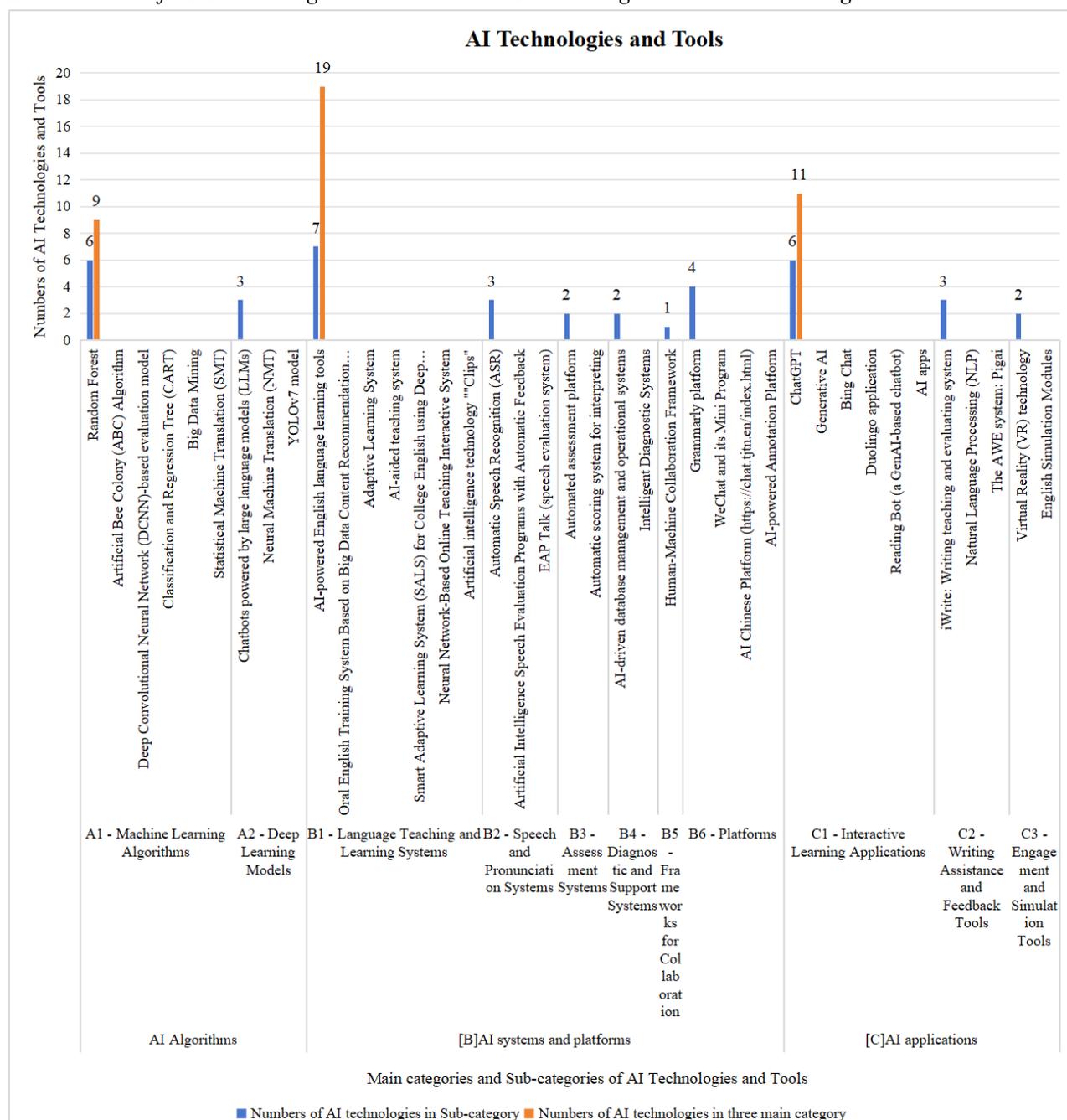


Figure 6 illustrates the distribution of AI technologies and tools across three main categories and eleven sub-categories. The dominant category is AI Systems & Platforms with 19 AI technologies (48.7%), followed by AI Applications with 11 AI technologies (28.2%). However, AI Algorithms with 9 AI technologies (23.1%) are the least frequent. Moreover, the most frequent subcategory is Language Teaching and Learning Systems, comprising 7 AI technologies (17.9%), followed by Machine Learning Algorithms and Interactive Learning Applications, each comprising 6 AI technologies (15.4% each), and Platforms accounting for 4 AI technologies (10.3%). Speech and Pronunciation Systems, Deep Learning Models, and Writing Assistance and Feedback Tools each have 3 AI technologies (7.7% each), Assessment Systems, Diagnostic and Support Systems, and Engagement and Simulation Tools each consist of 2 AI technologies (5.1% each). In contrast, the least frequent subcategory is Frameworks for Collaboration, with only one explicitly listed AI technology.

Figure 6
Distribution of AI Technologies and Tools on Main Categories and Sub-Categories

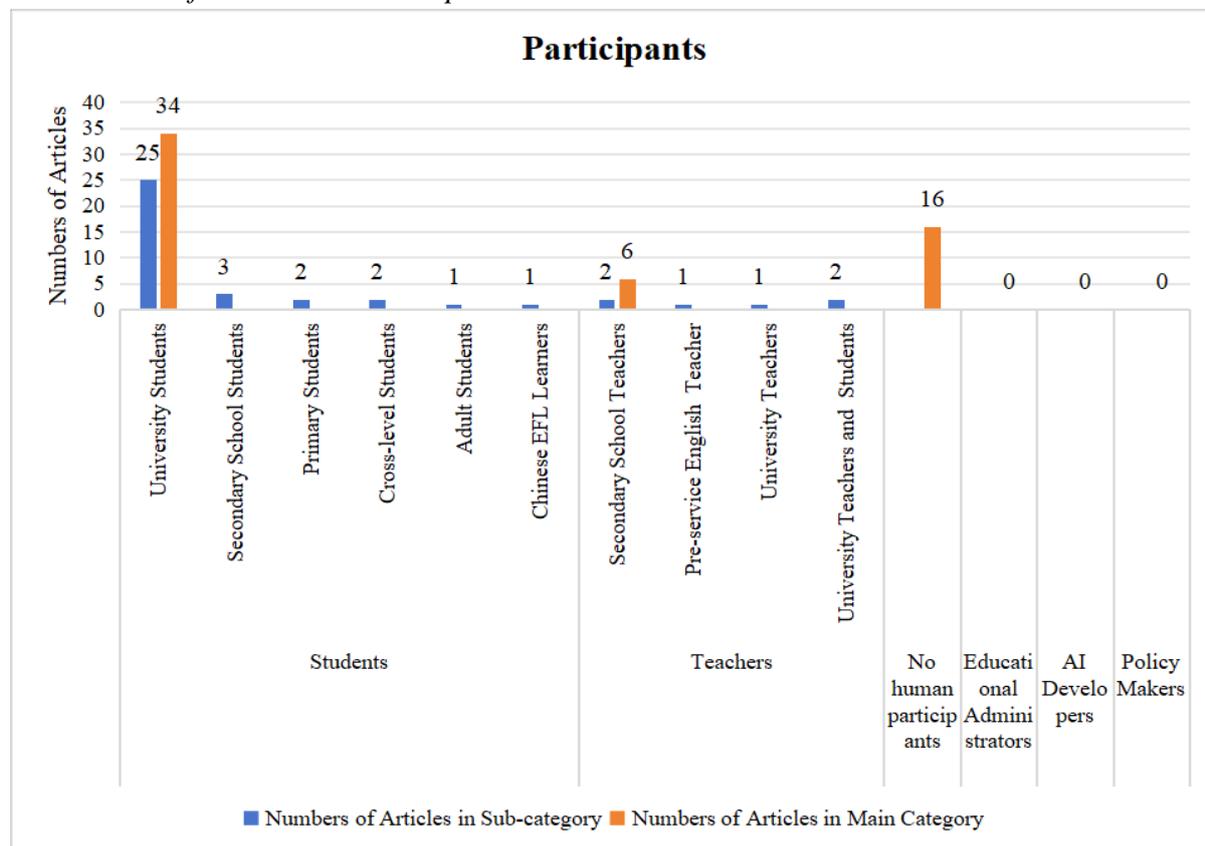


Participants

Figure 7 illustrates participants' distribution. Among the main categories, Students are the most common, comprising 34 articles (60.7%), followed by Teachers with 6 articles (10.7%), No Human Participants accounting for 28.6% (16 articles) of the total, no article involved Educational Administrators, AI Developers, and Policy Makers. Additionally, in sub-categories, University Students comprised the highest proportion of participants at 44.6% (25 articles). Secondary School Students, encompassing both junior and senior high school students, represented 5.4% (3 articles). Primary School Students, Cross-level Students (including both secondary school and university students), Secondary School Teachers, and

University Teachers and Students each constituted 3.6% (2 articles each) of the total participants. The lowest proportion of participants consisted of Adult Students, Chinese EFL Learners, Pre-service English Teachers, and University Teachers, each accounting for 1.8% (1 article each) respectively.

Figure 7
Distribution of Articles on Participants

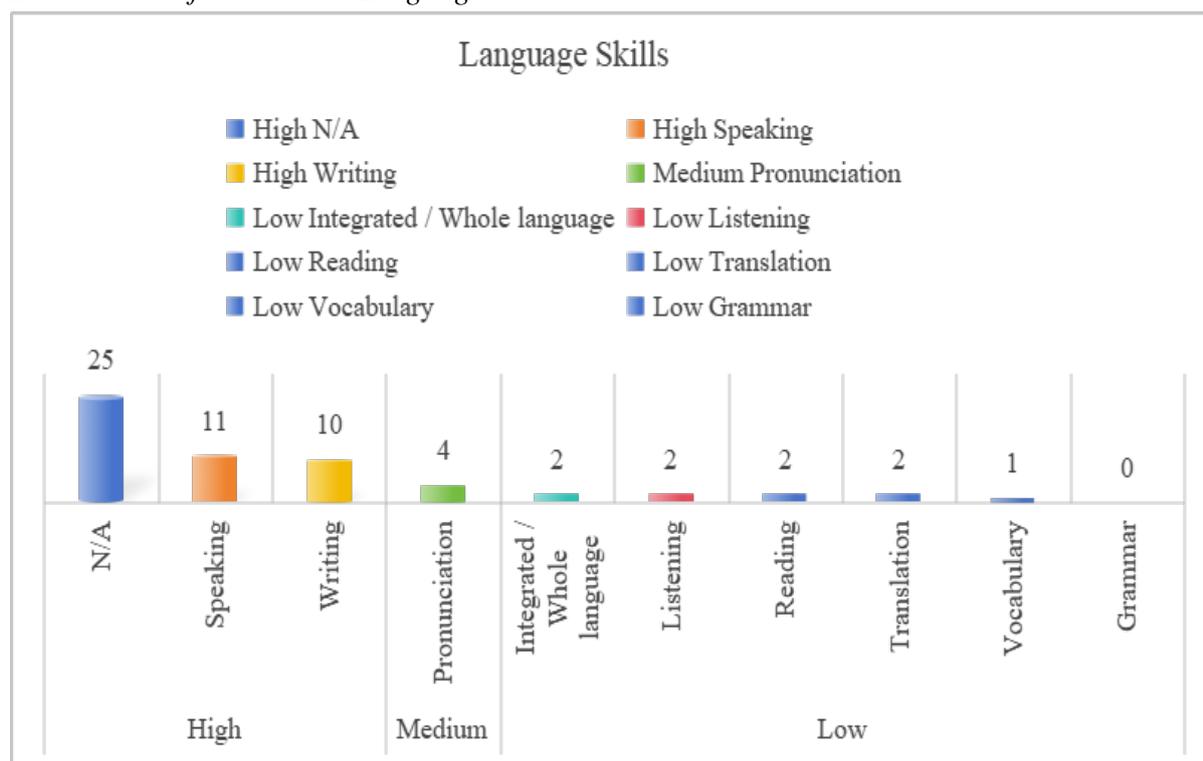


Language Skill Domains

Figure 8 illustrates the English language skills examined in the selected articles. Speaking represents 19.6% (11 articles), making it the most prevalent skill mentioned, and writing accounts for 17.9% (10 articles), followed by pronunciation at 7.1% (4 articles). Integrated/Whole language (2 articles), Listening (2 articles), Reading (2 articles), and Translation (2 articles) each constitute 3.6%, while Vocabulary (1 article, 1.79%) is the least covered English language skill. Selected articles did not address grammar. Additionally, 25 articles, representing 44.6% of the total articles reviewed, did not discuss language skills.

Figure 8

Distribution of Articles on Language Skills

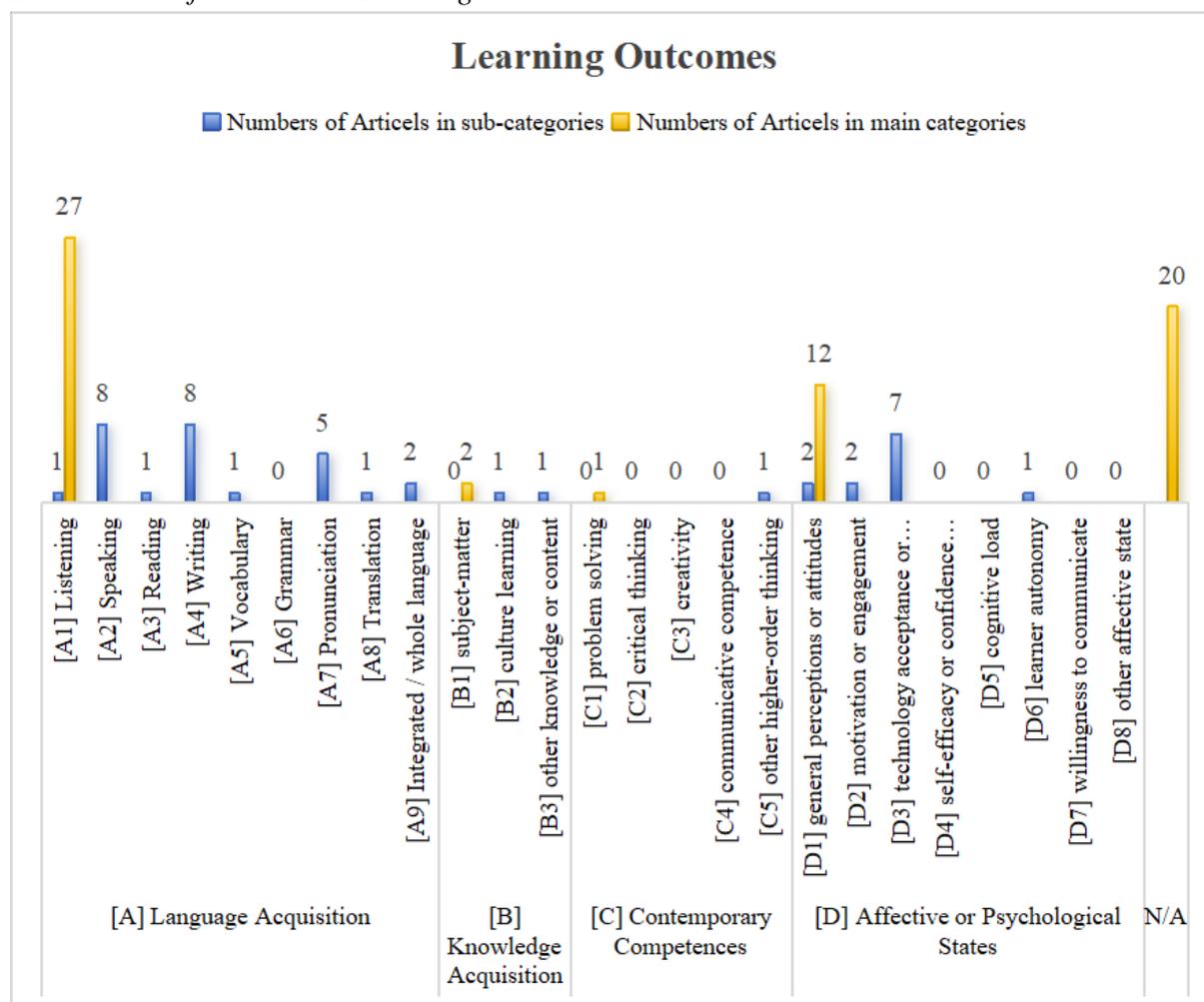


Learning Outcomes

Figure 9 shows the distribution of learning outcomes. The results of learning outcomes in the 5 main categories are as follows: Language acquisition (27 articles, 48.2%) is the most common, with Affective or Psychological States (12 articles, 21.4%) in close second, and with N/A (20 articles, 35.7%) representing a significant portion. Knowledge Acquisition (2 articles, 3.6%) and Contemporary Competencies (1 article, 1.8%) are the least frequent. The distribution results in 31 sub-categories are also shown in Figure 9. Speaking and Writing (8 articles each, 14.3% each) ranks first, Technology Acceptance or Evaluation (7 articles, 12.5%) comes second, followed by Pronunciation (5 articles, 8.9%), Integrated / whole language, General Perceptions or Attitudes, and Motivation or Engagement (2 articles each, 3.6% each). While Listening, Reading, Vocabulary, Translation, Culture Learning, Other Knowledge or Content, Other higher-order thinking, and Learner Autonomy (1 article, 1.8%) are the least discussed. No studies were conducted with Grammar, Subject-matter, Problem Solving, Critical Thinking, Creativity, Communicative Competence, Self-efficacy or Confidence, Cognitive Load, Willingness to Communicate, and Other Affective State.

Figure 9

Distribution of Articles on Learning Outcomes



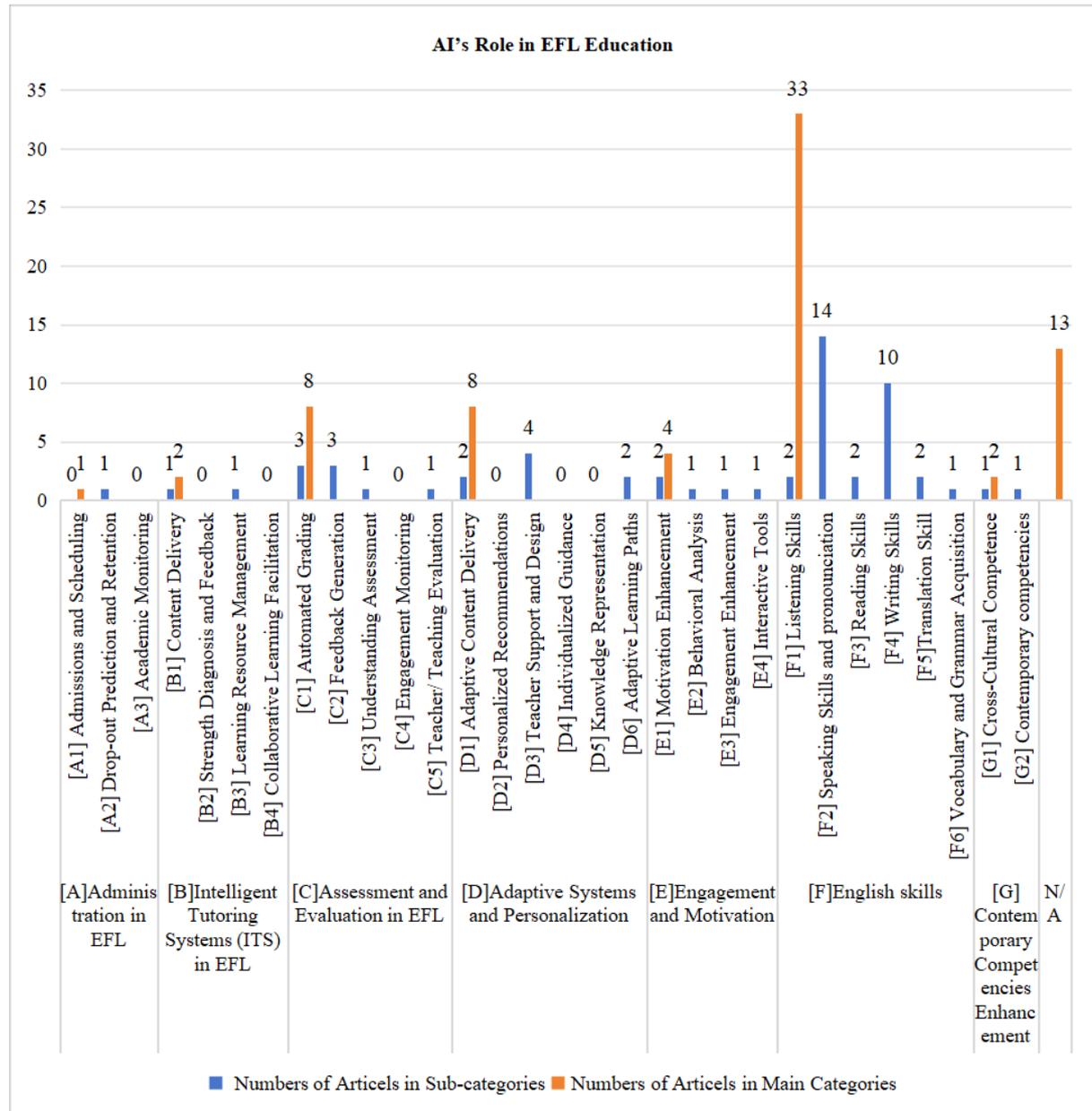
AI's Role in EFL Education

Figure 10 illustrates the distribution of AI's roles in EFL education. English Skills is the most prevalent category (33 articles, 58.9%), followed by Assessment and Evaluation in EFL, and Adaptive Systems and Personalization are less prominent with 8 articles each (14.3%), and Engagement and Motivation (4 articles, 7.1%). Intelligent Tutoring Systems (ITS) in EFL and Contemporary Competencies Enhancement are presented in only 2 articles each (3.6% each). Moreover, Administration in EFL is the least explored, with only 1 article (1.8%). Additionally, 13 selected articles (23.2%) did not examine the role of AI in EFL education.

Regarding distribution among sub-categories: Speaking Skills and Pronunciation comprise the majority with 14 articles (25%), followed by Writing Skills with 10 articles (17.9%). Moreover, Teacher Support and Design is presented in only 4 articles (7.1%). Furthermore, Automated Grading and Feedback Generation each have 3 articles (5.4%). Adaptive Content Delivery, Adaptive Learning Paths, Motivation Enhancement, Listening Skills, Reading Skills, and Translation Skills each consist of 2 articles (3.6%). Additionally, Content Delivery, Drop-out Prediction and Retention, Learning Resource Management, Understanding Assessment, Teacher/Teaching Evaluation, Behavioral Analysis, Interactive Tools, Engagement Enhancement, Vocabulary and Grammar Acquisition, Cross-Cultural Competence, and

Contemporary Competencies each have 1 article (1.8%). Finally, no articles discussed Admissions and Scheduling, Academic Monitoring, Strength Diagnosis and Feedback, Collaborative Learning Facilitation, Engagement Monitoring, Personalized Recommendations, Individualized Guidance, and Knowledge Representation.

Figure 10
Distribution of Articles on AI's Roles in EFL Education



Discussion

RQ1: What are the current trends of artificial intelligence in EFL education in China (2015-2024), focusing on publication years, research methodologies, implemented AI technologies, participants, and targeted language skill domains?

Trends in publication years

In the last decade, AI in EFL education research in China has been going through two stages: the slow growth years from 2015 to 2021 and the rapid development years from 2022 to 2024. The observed two-stage development of AI in EFL education research in China reflects the unique policy-driven approach to technological integration in education. China's top-down policy mechanism ensures research priorities align with national strategies, explaining the fast growth from 2022 to 2024. The rapid development stage directly correlates with major policy implementations like *Outline of the 14th five-year plan for national economic and social development of the People's Republic of China and the long-range objectives through the year 2035* (State Council of the People's Republic of China, 2021), *Guiding Opinions on Promoting New Educational Infrastructure to Build a High-Quality Education Support System* (MOE, 2021), and *Education Informatization 2.0 Action Plan* (MOE, 2018). These policies ensure strategic direction, substantial funding for AI-EFL integration, and research.

Trends in research methodologies

The results of research designs and methods indicate some significant trends: The dominance of Experimental Research and System, Model, or Tool Design (26.8% each) suggests a trend of controlled and intervention-based studies and technology innovation. The dominance of Experimental Research is in line with the previous studies (Liang et al., 2021; Yang & Kyun, 2022). And the dominance of System, Model, or Tool Design aligns with developments in AI-driven education (Luckin et al., 2016). This finding raises the risks of overlooking pedagogical methods and human concerns, as criticized by Selwyn (2019), who argued that educational technology research often highlights innovation over pedagogical expertise. Secondly, Experimental Research was dominated by Mixed and Quantitative Methods, while the qualitative method was absent. The finding indicates a gap in exploring English learners' and teachers' experiences in depth, which is also noted by Zawacki-Richter et al (2019). In addition, the limited overall application of qualitative methods (5 out of 56 articles) shows that phenomenological or narrative inquiries remain marginal in research in this field. The findings are in line with the previous reviews (Ji et al., 2023; Liang et al., 2021; Zhu & Wang, 2025), which found that mixed-methods and quantitative methods are predominant in AI in language education and emphasize the need for more qualitative methods to address the socio-cultural implications, deliver deeper insights into personalized learning. The unbalanced methodological trends can be attributed to the complex interplay of publication preference, methodological hierarchy, and characteristics of disciplines. Empirical and experimental studies are favored over theoretical, applied, and qualitative studies. This trend is evident in disciplines that prefer novel findings over conceptual advancements (Sandberg & Alvesson, 2021). Previous studies have indicated that experimental design prevails owing to its perceived rigor in showing causation (Shadish et al., 2002), while system design studies are common in technology-driven fields (Hevner et al., 2004).

Overall, the results of research methodologies demonstrate a combination of practical experimentation, applied solutions, and foundational theory, particularly highlighting mixed methods, quantitative methods, and AI-driven tool development. Nevertheless, significant gaps exist in qualitative methods. The shortfall of qualitative approaches in experimental research and the overall limited use of qualitative methods in AI in EFL educational research indicate a

gap in examining the experiences and perspectives of learners and teachers. As Selwyn (2019) argued that education is too complex to rely only on data and algorithms, even if their results seem impressive. Future research should encourage broader adoption of qualitative methods to explore contextual insights and to ensure balanced discourse in the field.

Trends in implemented AI technologies

ChatGPT is the most discussed AI tool, followed by AWE (Pigai), highlighting the transforming power of generative AI in EFL teaching and learning in China. This finding is different from the previous studies. Liang et al. (2021) found that intelligent tutoring systems were the most implemented AI technologies. AWE and ITS were the most popular AI technologies for writing in the study of Huang et al. (2018). Yang and Kyun (2022) observed that AWE, bots, machine translation, automatic speech recognition, and intelligent systems are dominant in language education. The differences could be caused by slightly different review domains, times, and periods. The dominance of ChatGPT may be related to its promises and benefits in education, as Al-khreshehm (2024) emphasized that ChatGPT greatly enhanced language instruction by delivering individualized feedback, enhancing autonomy, promoting student motivation and engagement, and improving specific language skills. ChatGPT demonstrates significant promise in language education by enhancing L2 writing instruction (dos Santos et al., 2023), facilitating adaptive vocabulary learning (Kohnke et al., 2023), and supporting teachers in content creation and lesson planning (Farrokhnia et al., 2023). However, the heavy focus on ChatGPT risks overshadowing other valuable AI tools. For instance, automated writing evaluation (AWE) systems like Pigai have proven effective in providing multifunctional feedback (Gao, 2021) yet have received far less attention. Additionally, emerging technologies like VR and NLP show growing interest but remain underutilized, indicating underexplored areas with high potential. The underlying reasons for the underutilization of VR and advanced NLP may be the investment cost. As Akinradewo et al. (2025) found, investment cost was the main hindrance to utilizing augmented reality technologies. Many institutions, particularly in less flourishing regions, prioritize cost-effective AI solutions (e.g., ChatGPT, Pigai) over immersive technologies.

The present study further categorized the reviewed AI technologies into three main categories and eleven sub-categories. The dominant category is AI Systems & Platforms, while the least discussed main category is AI Algorithms. Moreover, the most frequent subcategory is Language Teaching and Learning Systems, while the least discussed subcategory is Collaboration frameworks. It is noteworthy that Collaboration frameworks are largely overlooked, even though they could foster more interactive and immersive learning experiences. By addressing the discussed gaps, EFL education in China can achieve more effective and inclusive AI-powered learning environments.

Trends in participants

The distribution of research participants indicates a significant emphasis on university students, while Secondary School Students and Primary School Students are the least represented. Teachers are substantially underrepresented and receive limited attention. These results are consistent with Liang's (2021) review, which observed that the AILEd research primarily concentrated on university students rather than K12 education students. As argued by Hsu et

al. (2012), most studies in AI in EFL education are led by university researchers, who have easy access to observe and collect data from university students rather than young learners. In addition, the absence of key stakeholders such as policymakers, artificial intelligence developers, and educational administrators in the reviewed articles underscores a focus on end users—specifically, teachers and students—rather than those who design, manage, and supervise educational systems. Despite the considerable diversity in sub-categories, such as primary school students, adult learners, and Chinese EFL learners, their limited representation indicates that these populations continue to be marginal in the broader research landscape. The overall findings are in line with Zhu and Wang (2025) reviewing AI in language education. The findings of the shortfall of adult or lifelong EFL learners align with the findings of Hsu et al. (2012).

In conclusion, there are noticeable gaps in the participant distribution. Students in elementary and secondary schools, who are essential to understanding elementary and adolescent learning, are significantly underrepresented. Additionally, the lack of educational administrators, politicians, and AI developers suggests a gap between research and the educational ecosystem, which depends on them for innovation and systemic change. Notably, the lack of comparative or longitudinal studies with cross-level participants demonstrates limited understanding of educational continuity. Furthermore, Non-traditional learning environments are becoming more and more important in today's quickly changing educational and professional landscapes. Therefore, future studies should pay more attention to young learners, stakeholders like educational administrators, politicians, AI developers, and adult and lifelong learners. Teachers play an important role in enhancing the effectiveness of EFL teaching and learning in the AI age (e.g., Celik, 2023; Tegos et al., 2014; Zawacki-Richter et al., 2019). Therefore, future research should put more effort into examining teachers' experience, pedagogical inventions, AI literacy, and professional development. In addition, collaborative cooperations among educational institutions and stakeholders are called for in future studies.

Trends in targeted language skill domains

In terms of targeted language skill domains. The reviewed articles mostly concentrated on productive language skills, addressing Speaking and Writing. Additionally, pronunciation garnered significant attention. However, Listening, Reading, Translation, and Integrated language proficiency were inadequately examined. Moreover, grammar was completely overlooked, while vocabulary was addressed just marginally. The findings vary from previous reviews. In Zhu and Wang's (2025) study, speaking skills dominated while gaps were observed in reading, translation, listening, grammar, and vocabulary. Liang et al (2021) found the dominance of reading and vocabulary. The variances could be caused by different review periods and review scopes.

In short, whereas AI research in EFL education in China has predominantly focused on speaking, writing, and pronunciation, major gaps remain in grammar, vocabulary, translation, and integrated language proficiency. This aligns with the need for future research exploring AI applications in integrated language skills rather than specific language skills (Zhu & Wang, 2025). Prioritizing integrated language competency in AI in EFL studies not only aligns with whole-language theories emphasizing intertwining of all language skills (Aydoğan & Akbarov,

2014) but also utilizes AI's strengths in multiple modes of communication (Vartiainen & Tedre, 2023).

RQ2: What are the learning outcomes and the AI's role in EFL education?

Learning outcomes

Language Acquisition is the most extensively examined learning outcome, accounting for over fifty percent of the selected papers. While Affective or Psychological States is the second-largest category. These findings align with Hung et al.'s (2018) study on DGBLL (Digital Game-based Language Learning and Liang's review of AILEd. Additionally, A substantial percentage of articles classified as "N/A" suggests that numerous studies fail to define a clear learning outcome or that the outcome does not correspond with the primary categories. This could result from the exploratory character of AI research in EFL education in China, where outcomes may be less clearly defined or assessed in ways that do not conform to established categories. Furthermore, a limited number of studies concentrate on Knowledge Acquisition. Most notably, only a single study investigated Contemporary Competencies, which are critical in today's educational context. As Foster and Piacentini (2023) argued, educational policymakers worldwide increasingly prioritize 21st-century skills. Future studies should explore how AI tools can facilitate contemporary competencies and 21st-century skills and develop more comprehensive frameworks for assessing and fostering contemporary competencies and skills in AI in EFL educational settings. Moreover, critical gaps that previous reviews did not address were observed in the following sub-categories of learning outcomes: Grammar, Subject-matter, Problem Solving, Critical Thinking, Creativity, Communicative Competence, Self-efficacy or Confidence, Cognitive Load, Willingness to Communicate, and Other Affective State. No selected studies were focused on the above sub-categories. Therefore, future research should prioritize investigating these underexplored areas.

Overall, AI's impact on EFL education in China is primarily examined on language acquisition and affective or psychological states, indicating significant potential for further exploration. Future research may explore knowledge acquisition and contemporary competencies to enhance the understanding of AI's potential in language education. Furthermore, future research should examine the longitudinal impacts and mechanisms behind the learning outcomes, as recommended by Qiao and Zhao (2023).

AI's role in EFL education

The distribution of AI's role in EFL education reveals important trends, knowledge gaps, and areas for research. Compared with Liang's (2021) findings, there are significant differences. In Liang's (2021) review, the intelligent tutoring system was the most discussed, followed by Assessment and Evaluation, and then Adaptive Systems and Personalization. In the present review, English skill is the most discussed, followed by Assessment and Evaluation, and Adaptive Systems and Personalization. AI's role in enhancing language skills is mainly focused. In contrast to Liang's (2021) findings, limited research was conducted to explore the Intelligent Tutoring System (ITS) in EFL. Notably, AI's roles in Admissions and Scheduling, Academic Monitoring, Strength Diagnosis and Feedback, Collaborative Learning Facilitation, Engagement Monitoring, Personalized Recommendations, Individualized Guidance, and Knowledge Representation remained under-researched. The shifting focus from Intelligent

Tutoring Systems (ITS) to English skill enhancement in AI-assisted EFL education can be attributed to broader technological advancements and constraints. Recent advancements in natural language processing (NLP) and Conversational AI and Chatbots (e.g., Duolingo, automated writing evaluators, ChatGPT) have enabled more direct applications for language skill development (Bilgi, 2025). Significant gaps remain in understanding AI's role in Collaborative Learning, Facilitation, and Engagement Monitoring. This could be due to the technical limitations of AI tools or systems to model complex social interactions (Holstein et al., 2019). Similarly, gaps in AI's role in Knowledge Representation and Individualized Guidance could be caused by the constraints of AI technologies providing guidance and educational recommendations for each learner with unique needs, preferred learning modes, and varied achievement levels (Al Balushi, 2024). Another underlying reason could be investment cost, as termed by Akinradewo et al. (2025), the advanced AI technologies applied in these areas require vast investments.

In short, although the selected review articles highlight AI's role in enhancing English skills, considerable gaps persist in the individualizing, administrative, and collaborative aspects. These gaps suggest AI's current role in EFL remains supplemental rather than transformative. Addressing these gaps can help AI achieve its transformative role and improve pedagogical and learning results in EFL education.

Conclusion

Fifty-six articles published on AI in EFL in China between 2015 and 2024 in ERIC, ScienceDirect, Scopus, and CNKI were reviewed to provide new insights into and evidence for AI in EFL research and practice. The analysis encompasses seven key domains, including publication years, research methodologies, AI technologies and tools, the participants, language skills, learning outcomes, and AI's role in EFL education, providing a systematic examination of AI implementation in China's EFL education landscape with various findings. The findings are as follows:

The results highlight that AI in EFL education research in the past decade has been evolving in two phases: a slow development stage (2015–2021) and a fast development stage (2022–2024), therefore indicating that Chinese research in this domain is still in its early but rapidly developing stage. Furthermore, in terms of research methodologies, experimental and empirical research are both dominated by mixed methods and quantitative methods, while qualitative studies are overlooked. Regarding AI technologies tools, AI-powered systems and platforms—especially ChatGPT and the AWE system Pigai—are extensively discussed, while AI algorithms get less attention. Moreover, the participation of policymakers, AI developers, and educational administrators is prominently absent, and AI research mostly concentrates on university students. Concerning language skills, speaking, writing, and pronunciation are the most often studied skills; integrated/whole language acquisition, listening, reading, and translation receive little attention. No research has examined grammar. Although AI's role in English language skills development is well-documented, its role in administrative support, engagement and motivation enhancement, and facilitating contemporary competency is rarely discussed.

The results of this systematic review have significant implications for researchers, teachers, policymakers, and artificial intelligence developers in the field of EFL education. First, the

rapid expansion of AI in EFL education from 2022 onward indicates a promising opportunity, but future research must address its unbalanced focus. Second, the oversight of teachers and other stakeholders calls for a broader research scope to include diverse educational levels of participants and stakeholders such as policymakers, AI developers, and educational administrators. Additionally, the dominance of experimental and empirical research using mixed methods and quantitative methods highlights the necessity of more qualitative studies to address the socio-cultural implications, deliver deeper insights into personalized learning. Educators and AI developers should utilize AI's potential to develop not only English language skills but also facilitate contemporary competencies and 21st-century skills. Furthermore, policymakers should encourage interdisciplinary cooperation to develop EFL-contextualized AI tools, comprehensive policies, guidelines, and frameworks that help to keep the balance between AI innovations and ethical and pedagogical concerns.

Overall, the study emphasizes the importance of a more inclusive, balanced, multidisciplinary approach to AI in EFL education. Creating a more ethical, adaptive, and effective EFL educational environment by addressing research gaps, promoting diverse stakeholder collaboration, and integrating ethical considerations.

The review provides valuable trends and suggests potential research directions in AI within EFL education for researchers and practitioners. Nevertheless, the review includes only fifty-six articles published from 2015 to 2024. Due to the scope of this research, there are limitations. Firstly, different search strings produce different search results. It inevitably excluded some articles on this topic. Secondly, the present review only searched four databases: Scopus, ScienceDirect, Eric, and CNKI for collecting articles. These databases cannot provide all relevant studies published on AI in the reviewed field. Thirdly, the review was conducted by the AI in the EFL research review model, thereby constraining the analysis to the established categorization and coding schemes. To address these limitations, future studies can explore AI in EFL education more broadly and expand the search strings to examine AI in EFL in other specific countries or regions. Further studies may also extend this study by including additional studies from other databases with expanded periods. Additionally, future research could consider using other frameworks or analysis techniques.

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Ethics Declarations

Competing Interests

Miss. Zongbi Qin has two affiliations as a Ph.D. candidate at Mae Fah Luang University in Thailand and a lecturer at Chuxiong Normal University in China. The copyright of this paper

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Appendix A

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