

## **Bibliometric Analysis of Artificial Intelligence Integration in English as a Foreign Language Education: Trends and Patterns**

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### **Abstract**

*This research presents a comprehensive bibliometric analysis of the integration of artificial intelligence (AI) in English as a Foreign Language (EFL) education, focusing on trends, patterns, and implications within the scholarly literature. By examining journal articles published between 2010 and 2024, this study reveals a significant increase in publications on AI integration in EFL education, particularly after 2019, possibly influenced by the shift to online teaching during the COVID-19 pandemic. The analysis identifies China as the most productive country in this field, followed by Taiwan and Saudi Arabia. Furthermore, the study highlights key authors and documents contributing to the discourse, shedding light on the most cited articles and prolific authors. The findings underscore the growing interest and potential of AI in transforming EFL education, offering insights for educators, researchers, policymakers, and technology developers to leverage the transformative power of AI effectively. Recommendations for future research directions and considerations for publishing in relevant journals are also provided. Despite the limitations of relying solely on the Scopus database, this research sets the stage for further exploration of AI integration in EFL education and emphasizes the need for continued investigation and innovation in this evolving field.*

**Keywords:** *Artificial intelligence, EFL, research trends, research patterns*

### **INTRODUCTION**

In today's rapidly evolving educational landscape, integrating Artificial Intelligence (AI) technologies has emerged as a transformative force, reshaping traditional pedagogical approaches across diverse disciplines (Gruetzemacher & Whittlestone, 2022). Among these disciplines, English as a Foreign Language (EFL) education stands at the forefront of AI integration, leveraging innovative tools and methodologies to enhance teaching and learning experiences (Sumakul et al., 2022). The intersection of AI and EFL education represents a dynamic and multifaceted field, characterized by a burgeoning body of research, technological advancements, and pedagogical innovations.

The adoption of AI in EFL education holds immense promise, offering unprecedented opportunities to address longstanding challenges and optimize learning outcomes for learners worldwide (Ruihong, 2022). From intelligent tutoring systems and language learning applications to automated assessment tools and adaptive learning platforms, AI-powered solutions are revolutionizing the way EFL instruction is delivered, personalized, and assessed. By harnessing the power of machine learning algorithms, natural language processing techniques, and big data analytics, educators can tailor instructional content, provide real-time

feedback, and customize learning pathways to meet the diverse needs and preferences of individual learners (Iqbal, 2023).

Against this backdrop of rapid technological advancement and pedagogical innovation, there exists a growing body of scholarly literature aimed at elucidating the trends, challenges, and implications of AI integration in EFL education. However, the sheer volume and complexity of this literature pose significant challenges for researchers, educators, policymakers, and other stakeholders seeking to navigate and make sense of this rapidly expanding field (Memisevic et al., 2023). In this context, bibliometric analysis offers a powerful methodological tool for systematically synthesizing, analyzing, and visualizing the scholarly discourse surrounding AI integration in EFL education (Donthu et al., 2021).

Bibliometric analysis, rooted in quantitative methods and scientometric principles, enables researchers to examine patterns of publication, citation, collaboration, and impact within a specific research domain (Lim & Kumar, 2024). By leveraging bibliometric techniques, researchers can identify key trends, influential authors, seminal works, and emerging research trajectories, thereby providing valuable insights into the intellectual structure and dynamics of a given field (Ninkov et al., 2022). In the context of AI integration in EFL education, bibliometric analysis holds the potential to uncover hidden patterns, map the diffusion of knowledge, and inform evidence-based decision-making in research, practice, and policy.

This research endeavors to undertake a comprehensive bibliometric analysis of AI integration in EFL education, with a specific focus on identifying trends and patterns within the scholarly literature. By systematically collecting and analyzing metadata from the Scopus database, an internationally acknowledged and well-established indexer, this research aims to contribute to the ongoing discourse surrounding AI integration in EFL education by providing a nuanced understanding of the current state of research, highlighting emerging trends, and identifying potential avenues for future inquiry and innovation. By synthesizing and visualizing the scholarly landscape, this research seeks to empower educators, researchers, policymakers, and technology developers with the knowledge needed to navigate and leverage the transformative potential of AI in EFL education effectively. To achieve these objectives, this research aims to answer the following research problems:

1. What are the annual publication trends of AI integration in EFL education articles?
2. What are the geographical distributions of AI integration in EFL education publications?
3. What are the most productive universities for AI integration in EFL education publications?
4. Who are the most prolific authors of AI integration in EFL education publications?
5. What is the most cited AI integration in EFL education articles?
6. What are the journals that mostly publish AI integration in EFL education articles?
7. What are the top used keywords across years in AI integration in EFL education articles?

8. What were the prevailing topic trends in AI integration in EFL education publication?

## **METHOD**

### **Approach and Type of Research**

The study utilized a quantitative approach with a descriptive analysis, employing the bibliometric method to examine journal articles pertaining to AI integration in EFL education from 2010 to 2024. The research period was determined based on data obtained from Scopus, leaving the researcher without the ability to alter the chosen years. The bibliometric method was selected due to its robustness in analyzing citations, text, and data mining, as established by Nerur et al. (2008) and Howard & McCain (1998).

### **Data Collection**

Two criteria elicited the data for the present research: the specified keywords and the time period. The keywords inserted into the Scopus (<https://www.scopus.com/>) database search engine were related to AI and EFL. The process of data mining from the Scopus database followed the following instruction: TITLE-ABS-KEY ('AI' AND 'EFL') to ensure comprehensive coverage of the relevant literature. Subsequently, the researcher obtained a CSV as the raw data for the analysis process. The general information of the downloaded data from the database is presented in Table 1.

Table 1. Description of Collected Data

Description	Results
<b>MAIN INFORMATION ABOUT DATA</b>	
Timespan	2010:2024
Sources (Journals, Books, etc)	76
Documents	112
Annual Growth Rate %	25,85
Document Average Age	1,59
Average citations per doc	6,08
References	4830
<b>DOCUMENT CONTENTS</b>	
Keywords Plus (ID)	254
Author's Keywords (DE)	389
<b>AUTHORS</b>	
Authors	272
Authors of single-authored docs	29
<b>AUTHORS COLLABORATION</b>	
Single-authored docs	29
Co-Authors per Doc	2,79
International co-authorships %	18,75
<b>DOCUMENT TYPES</b>	

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article	83
book chapter	4
conference paper	17
conference review	3
editorial	1
note	2
review	1
short survey	1

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### **Bibliometric Analysis**

For data analysis, the raw data were imported into three bibliometric analysis tools: Scopus Analytics, Biblioshiny, and VOSviewer. They were used to analyze data pertaining to AI integration in EFL education articles from 2010 to 2024. The following aspects were examined: the annual publication, the geographical distribution of the articles, the most productive university, the most prolific authors, the most cited articles, the journals that published related topic articles, the top-used authors' keywords, and the topic trend in the published articles.

### **Data Display**

The data was presented in the form of figures, charts, and tables, accompanied by explanatory text to ensure a clear comprehension of the findings. In this section, the utilization of three bibliometric software tools, Scopus analytics, Biblioshiny and VOS viewer, was highlighted, demonstrating a comprehensive approach to data analysis. The descriptions of the specific analyses performed using these tools provide clarity on the various aspects examined. The revised paragraph also emphasizes the presentation of the findings through suitable visualizations and the incorporation of explanatory text to facilitate understanding.

### **Limitations**

Although the Scopus database offers extensive coverage of scholarly literature, it may not encompass all relevant publications in the field. Moreover, the quality and precision of metadata may fluctuate across various sources, which could impact the credibility of our analysis. These constraints were considered during the evaluation of our findings.

## **RESULTS**

This research examined journal articles published between 2010 and 2024 that discussed how artificial intelligence (AI) is being integrated into English as a foreign language (EFL) education. The specific goals of the research aligned with the questions it aimed to answer. The findings are presented in the order of the research questions. The first question looked at trends in the number of publications on AI integration in EFL education over the years 2010 to 2024. To answer this, information from the studies was entered into a software program called Biblioshiny. Once processed, the results were visualized in Figure 1.

Figure 1. Annual Publication Trends

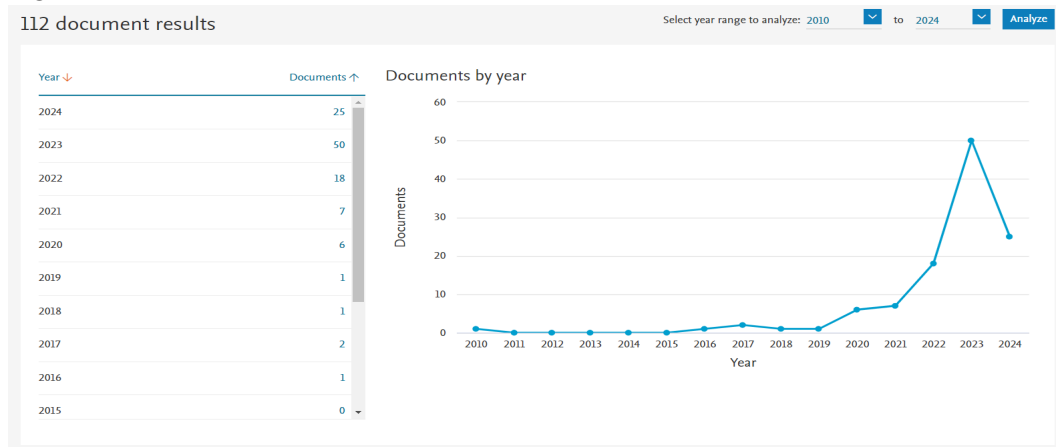
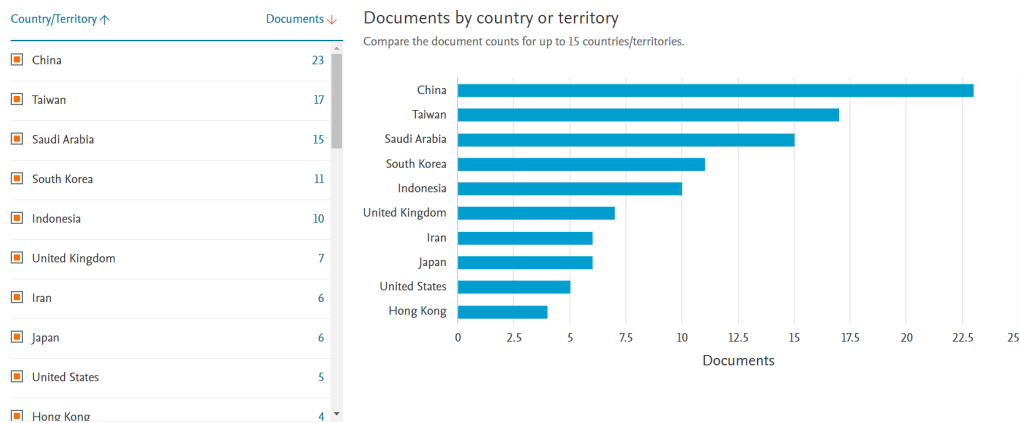


Figure 1 shows that the annual trends of publication on AI integration into EFL education increased steadily after 2019. It reached the peak in 2023 with 50 publications. Before 2019, the publication on this area remained low, with only around one publication yearly starting from 2010. The falling frequency of publication in 2024 does not mean that the publication number in 2024 is lower than 2023; it might be because the data mining for this research had been finished only until February 2024. So, there is a possibility that research publication in this topic will step higher than in 2023. Finally, the trend of publication on AI integration into EFL education could be caused by the need to embed technology into teaching more than before due to the COVID-19 pandemic situation, where onsite EFL teaching should be migrated into online.

Addressing the second research problem, the findings show that the most productive country to publish articles on AI integration into EFL education is China, with 23 documents. Then, it is followed by Taiwan with 17 documents and Saudi Arabia with 15 documents. The data for these explanations can be seen in Figure 2.

Figure 2. Geographical Distributions of the Publications



Comparing the continents, among the ten most productive countries shown in Figure 2, only two countries (United Kingdom and United States) from Europe and America continents are quite productive. United Kingdom produced 7 documents, and United States produced 5 documents of research publication on AI integration into EFL education.

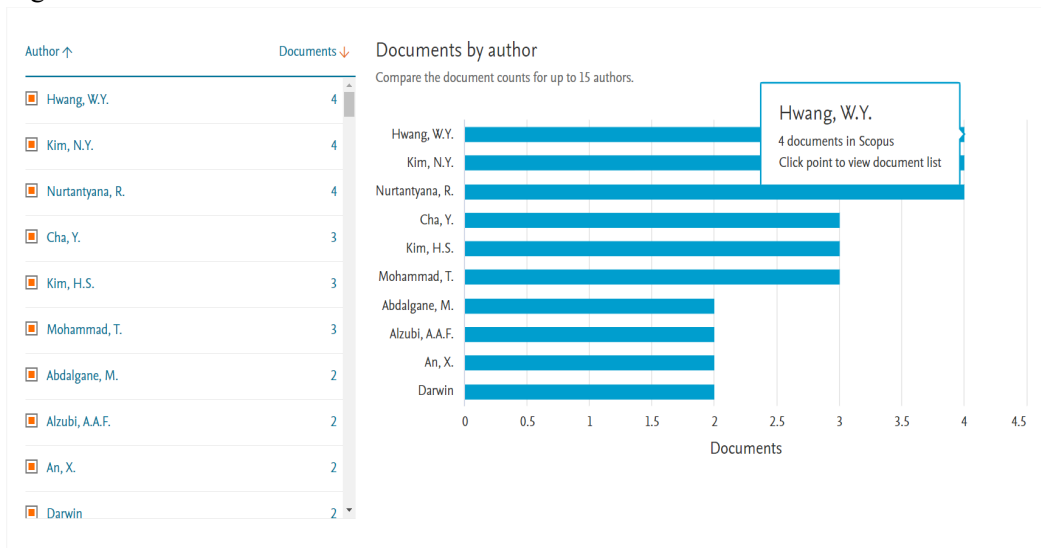
Moving to the third research question, which is to find the most productive university to publish research on AI integration into EFL education, it is known from Figure 3 that National Central University in Taiwan leads the board with 4 publications. The second most productive university is placed by some universities with 3 publications. The universities are Chinese University of Hong Kong, Xian Jiaotong University, Seoul Women’s University, Al Qassim University, Hanshin University, Xi'an Jiaotong-Liverpool University, and Najran University. Figure 3 shows its consistency with the data in Figure 2 about the most productive country, that the most productive universities are situated in the most productive countries.

Figure 3. Most Productive University for Publication



The fourth research objective is to determine the most prolific author in publishing research on AI integration into EFL education. Figure 4, which has been mined from the Scopus analytic website, shows that there are three most prolific authors: Hwang from Taiwan, Kim from South Korea, and Nurtantyana from Indonesia, each with four documents. These most prolific authors come from Taiwan, which is the second most productive country according to Figure 2. According to the published documents, Hwang and Nurtantyana commonly worked together for publication, which made them the most prolific authors.

Figure 4. The Most Prolific Authors



The next research objective is to know the big players on AI integration to EFL education publications in the period of 2010-2024. After the data analysis applying Biblioshiny, the analysis results are presented in Figure 5.

Figure 5. The Most Cited Documents

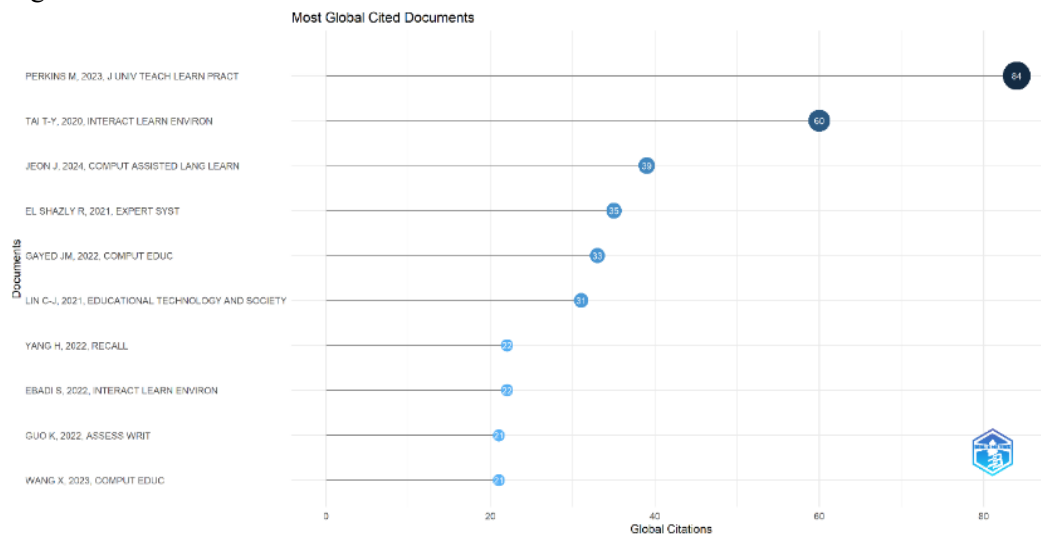


Figure 5 states that Perkins's (2023) article has been cited for 84 times, which made it the most cited document. This citation number surpassed the second most cited article by Tai (2020) with 60 citations. It is an unusual finding since Tai's (2020) article was published three years earlier than Perkins's (2023) article but had fewer citation records. Additionally, the third most cited article by Jeon (2024) had 21 fewer citation records than the second. It also reveals an interesting finding that Jeon's (2024) article had been published just a few months before March 2024 (the time when this research data was mined from Scopus database) but the citation had surpassed many other documents published in Scopus.

Figure 6. Most Cited Documents Mapping

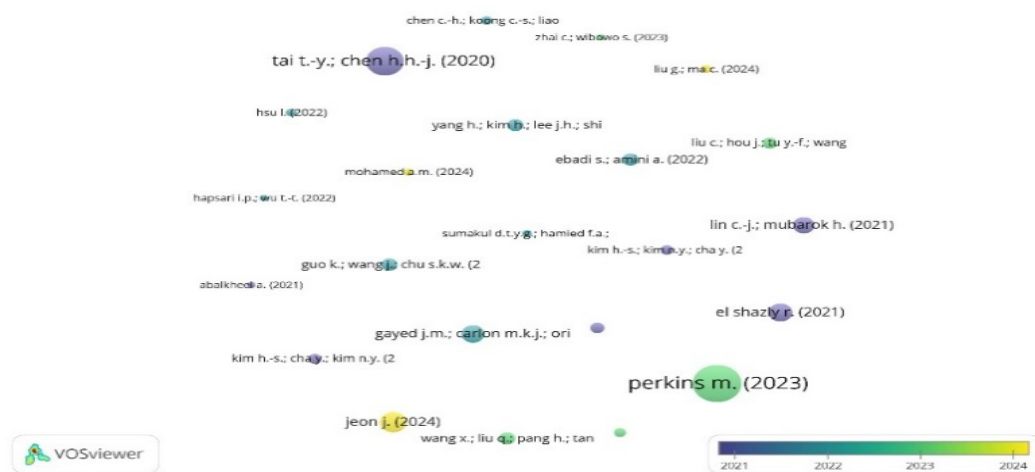


Figure 6 describes the map of the most cited document, which was downloaded from VOSViewer. The color of the dots shows the years of the document publication, and the dot's size represents the number of citations that the documents had. Observing Figure 6, it explains clearer that Perkins (2023) leads the board to have the most cited document. However, Perkins (2023) was not the most prolific author, according to Figure 4.

The sixth research problem searches for journals that mostly publish AI integration into EFL education. After mining data from the Scopus database, the researcher analyzed them with the Scopus analytical website, and the results are presented in Figure 7.

Figure 7. Journals with the Most AI-EFL Publication

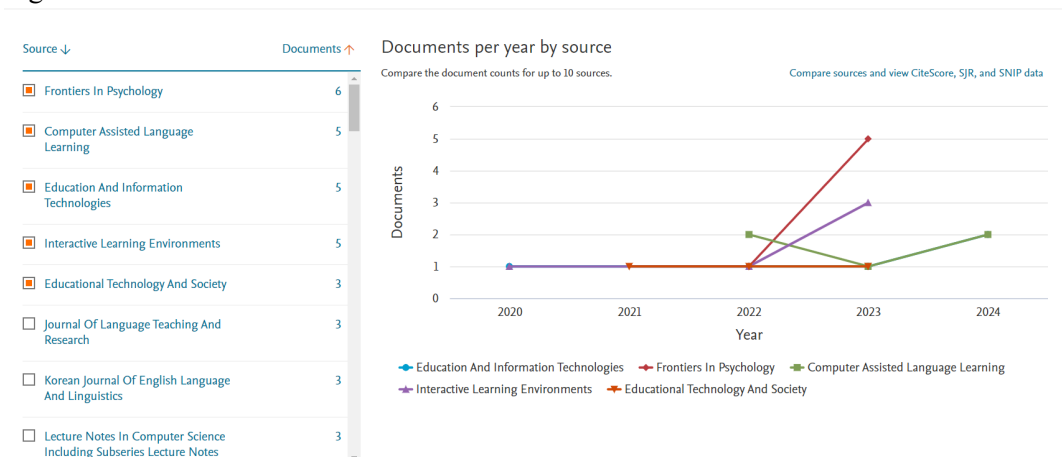


Figure 7 serves to find that there are 5 journals that mostly publish articles on AI integration into EFL education. The journals are Frontiers in Psychology, Computer Assisted Language Learning, Education and Information Technologies, Interactive Learning Environments, and Educational Technology and Society. According to the Scimago Journal Rank (ScimagoJR) website, those journals are top-tier journals in 2024 with Q1 and Q2 predicates. Figure 7 also shows that only



Following the minimum occurrence rule of four in the VOSviewer visualization process, the findings revealed 26 thresholds in Figure 9. This figure displays co-occurrences of keywords in articles comprising six clusters according to the colors (purple, green, yellow, dark blue, red, and light blue). The light blue cluster contained only two items (computer-aided instruction and learning system). Purple and yellow clusters each contained three-word items. More items appeared in the green cluster with five-word items. Then, the most frequently-appeared numbers in the items were seen in the dark blue and red clusters (six-word items).

AI or 'artificial intelligence' commonly co-occurred with 'students', 'EFL', 'ChatGPT', 'Chatbots', and 'Deep Learning'. The 'artificial intelligence' had 23 strings from 47 total of all co-occurrence links. By understanding the top-used keywords and the co-occurrence of the keywords, the trend of topics in AI integration into EFL education articles could be drawn, as shown in Figure 10.

Figure 10. Top Used Keywords Across Years

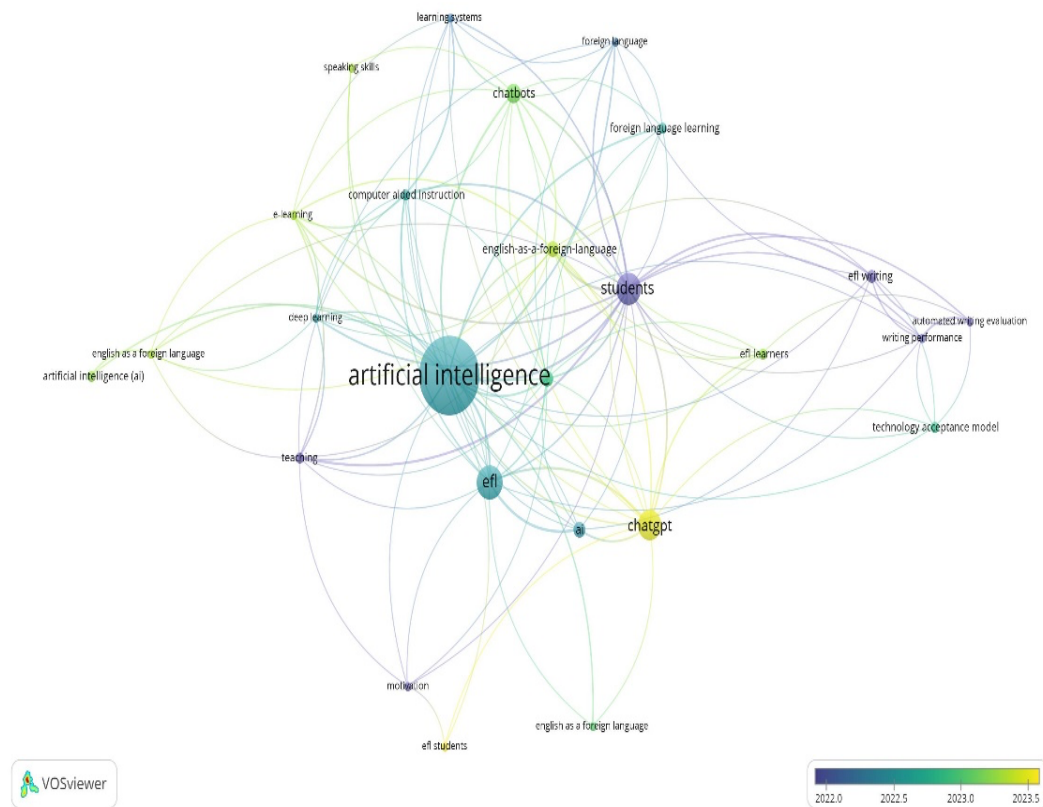
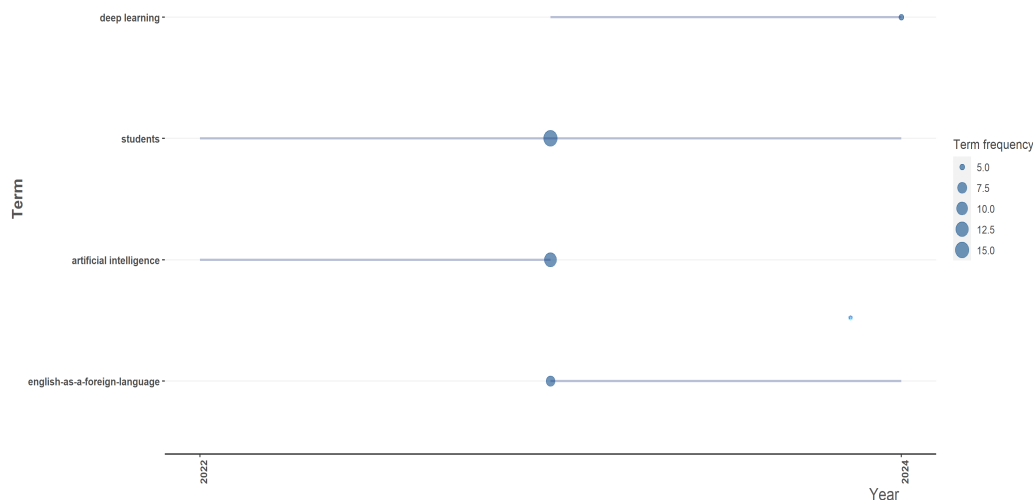


Figure 10 states that currently, AI integration into EFL education articles' trends are about 'ChatGPT' and 'EFL' as seen from the yellow color. These two topics commonly co-occurred with 'artificial intelligence', 'students', and 'Chatbots' recently. However, according to VOSViewer, there still needs to be a direct connection between 'artificial intelligence', 'ChatGPT', and 'EFL' to 'Automated writing evaluation', which may open the possibility for future research.

Figure 11. The Topic Trend of Publication



As comparison and enrichment, Figure 11 depicts the analysis of topic trend based on Biblioshiny tool processing. The figure shows that the topic on 'AI' shows its relevance until 2023 but has not yet shown its trend in the early months of 2024. Similar to VOSViewer analysis, 'EFL' still becomes a trending issue in early 2024. Finally, slightly different from VOSViewer, the research topic on 'deep learning' shows its potential for publication in the early years of 2024. Hence, according to the bibliometric analysis applying Biblioshiny, it is recommended for researchers to conduct studies with the topics of 'deep learning', 'EFL', 'AI', and 'students'.

## DISCUSSION

The present study investigated journal articles published between 2010 and 2024 that discussed how artificial intelligence (AI) is being integrated into English as a foreign language (EFL) education. Meeting the research problems and the findings of this study, the discussion will also follow the flow of the previous sections.

The annual trend of publication on the integration of AI into EFL education shows a promising future as shown by the steady increasing number of publications starting in 2020 (see Figure 1) and reached its peak in 2023. This finding shows similar fact to the increasing number of publications in article discussing the use of voice-based intelligent virtual agent in EFL education (Katsarou et al., 2023) and another article exploring various areas of AI in EFL education, including optimizing language skills, translation, assessment, recognition, attitude, and satisfaction (Sharadgah & Sa'di, 2022). The increasing trend to research the EFL education from the view of AI could be caused by the demand of sudden shift to use technology to scaffold online teaching during the Pandemic COVID-19 in 2019 (Khan et al., 2021). Many educators and engineers worked together to help the frustrated and busy EFL teachers with more easily operated technology including inserting AI technology, which then result rapid growth of research in this area.

The growth of AI integration into EFL education research appeared in the most productive country and continent, that is China in Asia continent (see Figure 2). The data shows that China leads the board as the most productive country and also situated some of its universities in the board of the most productive universities

(see Figure 3). It could be assumed that China as one of leading country in the development of modern technology affect the academicians to keep up with the latest technology for education, including AI, which impacts China research and publications (Knox, 2020). Nevertheless, the most prolific authors and the most cited document were not coming from China. The most prolific authors were Taiwanese, South Koreans, and Indonesian. While the most cited article was from Vietnam, by Perkins (2023). Hence, these findings evidenced that the most productive country title does not always correspond to its individual productivities, but it could be for collective productivities.

Regarding the number of citations and the top cited documents ranking in Figure 5 and Figure 6, as being stated in the findings, there was unique data. Perkins' (2023) article had more citation number than Tai's (2020) that was published earlier. Then, Jeon's (2024) that had just been published in few months before March 2024 obtained high number of citations than the rest of data. This finding indicates that year of publication does not guarantee to obtain more citation number and the interest of other to cite one's work might be affected by the article quality or topic similarity (Aksnes et al., 2019). Therefore, it is recommended for journal article author to compose their article that creates other researchers' interest to read and cite by choosing interesting and trendy research topic (Hallock & Bennett, 2021).

To understand the topic trend of research, the researcher can apply VOSViewer and Biblioshiny tools to analyses research publication data set (Kirby, 2023). Both tools provide visualization of topic trend based on the keywords used in the articles stored in the dataset with the samples shows in Figure 10 and Figure 11. Those figures expose that the publication trend in the area of AI integration into EFL education are about 'artificial intelligence', 'ChatGPT', 'deep learning', and 'EFL', which those topics were mostly researched with 'students' as the participants. However, it opens opportunity to conduct a research with the similar research interest by viewing from the 'teachers' side as the participants. Since those topics are still happening in 2024, the analysis shown in Figure 10 and Figure 11 suggested future researchers to conduct studies discussing those topics. Moreover, finding non-direct string link between those topics to 'automated writing evaluation' keyword, this area remain open for future investigation and publication.

Finally, to publish a journal article, an author should find best suited journal scope with their research topic (Suiter & Sarli, 2019). Also, finding reputable journal that commonly published similar interest research article with the authors is also preferable to minimize rejection (Khadilkar, 2018). Hence, to publish a research article with the topic on AI integration into EFL education, the authors can consider some journals that frequently publish such of the articles, such as *Frontiers in Psychology*, *Computer Assisted Language Learning*, *Education and Information Technologies*, *Interactive Learning Environments*, and *Educational Technology and Society*.

## **CONCLUSION**

This research analyzed 112 documents with the topic of AI integration into EFL education, which was mined from Scopus database. After the analysis to match with the objectives of this research, it can be concluded that the publication trend in the topic area had increased steadily especially after 2019. The dominant country

for publication on this area is China, with some of its universities contributing to the publications. However, China's dominance did not appear in the most prolific author and most cited document data. Then, it was listed that five Scopus top-tier journals with the publication scope about 'technology' prefer to publish articles with topics on AI integration into EFL education. In addition, the future direction of publication in the area of AI and EFL education is still promising. Moreover, if future researchers want to discuss this topic area with 'automated writing evaluation', they should consider this motivation. Henceforth, this research implied motivation for enriching studies in the recommended topic area.

However, there are limitations to these conclusions. The raw data were solely obtained from the Scopus database, while it is possible to gather more AI integration into EFL education articles from other databases such as WoS, Google Scholar, Microsoft Academic, etc., to gain a more comprehensive understanding. The researchers hope that future studies can address these shortcomings and limitations.

This research still offers ample room for improvement and optimization. First, it is necessary to explore the interconnections of the variables in the present research problems to enhance predictive capabilities in the future. Second, future researchers can expand the discussion on a similar topic using multiple databases. It is recommended that researchers stay updated with the latest trends and conduct further investigations on AI and EFL education research.

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