Artificial Intelligence in English Language Teaching

------ CiteSpace-based Visualisation and Analysis

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Abstract. Artificial Intelligence, from its birth, facilitates educational applications to form an unbreakable bond, bringing new technology and new tools for the development of education, which has gradually attracted greater attention from the education and academic circles at home and abroad. The application of Artificial Intelligence in English teaching can play a good role in assisting teaching. In order to study the current status of domestic and international research on artificial intelligence in the field of English teaching and to grasp the research trend, this study uses CiteSpace visual analysis software to analysis the institutions, the countries or regions engaged in the research, the change in the number of articles issued, and the keywords. The results of the study show that the application of artificial intelligence in English language teaching has received more and more attention in recent years, with the United States, China and the United Kingdom leading the majority of research in this area, and the direction of the research is mostly based on online teaching, artificial intelligence technology, learning analytics, and the English language. In future research, communication and exchange between countries and institutions should be strengthened to jointly promote the application of AI in English language teaching.

Keywords: Artificial Intelligence; English language teaching; CiteSpace; Visual analysis

1   Introduction

In 1966, the paper "*Computers and Human Mind Introduction to Artificial Intelligence—Fink, DG*"[1] published by *Reno, EA* showcased the emergence of the research of Artificial intelligence. Intelligence computer systems have long been a subject of science fiction. Now, we are entering an era in which Artificial Intelligence (AI) is having broad and deep impacts on our daily lives, ranging from precision medicine to transportation to education and more. The emergence and development of AI

has had a significant impact and change on the whole process of English teaching. Teaching and learning systems with artificial intelligence technology can provide a richer experience for learners and offer new opportunities for researchers [2]. In order to expand the scale of teaching and improve teaching efficiency, traditional teaching adopts the "classroom system", which ignores the differences between different individuals. The arrival of the Artificial Intelligence era makes the teaching organization tend to personalized teaching [3]. Prospective teachers and teacher educators are experimenting with integrating technology into their teaching practices [4]. In order to adapt to the students' own development, future education should pay more attention to the diversified development of students, provide project practice of real problem scenarios based on Artificial Intelligence, stimulate students' interest in learning and cultivate their innovative thinking.

So, what is the current trend of research publications on the use of AI in English language teaching? In what aspects does the research focus? What kind of characteristics and shortcomings are presented? What might be the future research trends on this aspect? These questions are the focus of this study, and CiteSpace is used to visualize and analysis the current status of research on the application of AI in English language teaching and to provide suggestions for further research.

2 Research Methods and Tools

2.1 Date Sources

In this study, the core data collection of Web of Science databases (including SCI and SSCI) was used as the data source, and the search terms were "Artificial Intelligence", "English education", "English teaching". The research direction is "Education Educational Research", the literature type is "Artistic", and the language is "English". The search period was from 2003 to 2023 and the language is English. A total of 540 documents were selected as the sample for this study, excluding those that did not fit the theme.

2.2 Research Methods and Tools

This study mainly used CiteSpace software for the econometric analysis of the data. CiteSpace is a visual modeling developed by Professor Chen Chaomei's team Software, with cooperative network analysis, co-citation analysis, keyword analysis, etc. Multiple visualizations can be used to explore research trends in the academic field. Test the future research trend [5]. Using CiteSpace, the structure, patterns and distribution of scientific knowledge are presented through visualization [6].

The 540 literature records obtained from screening were used as the research data for this paper, which were quantitatively and qualitatively analyzed with the help of CiteSpace software, the bibliometric and data visualization analysis methods[7] were used to comprehensively analyze the original literature in terms of the year of publication, the distribution of countries, the distribution of institutions and authors, the co-occurrence of keywords, and so on, to sort out the research themes of the develop-

ment of AI in English language teaching. Meanwhile, this study draws the scientific knowledge mapping [8] of related research to explore the hot trends of the application of AI in English language teaching research.

3   Research Results and Analysis

3.1   Changes in publication volume

The 540 documents obtained from the screening were categorized according to the year of publication, which resulted in a graph of the trend of the annual volume of articles (Figure 1). As can be seen from Figure 1, there were fewer studies on the application of AI in English language teaching between 2003 and 2008, and the number of published articles began to grow from 2010 onwards, and the growth was very rapid after 2016, and there has been a sudden increase from 2020 to the present. It shows that the application of AI in English language teaching has received great attention from the education session. Combined with the background of the times, it can be known that on 3 May 2016 the US White House released *The national artificial intelligence research and development strategic plan*. It said that AI has the potential to revolutionize how we live, work, learn discover and communicate [9]. Therefore, in the field of education, it will be greatly affected by AI, and how to make better use of AI as a tool to assist our education and teaching has gained the deep attention of people in the education sector [10]. 2017 China introduced the *"New Generation Artificial Intelligence Development Plan"*, which proposes to reserve talents to meet future challenges through the combination of AI and curriculum [11]. English as a world language, learning English well is a crucial course no matter in which country's education field, combining AI with English curriculum teaching has received great attention from scholars in recent years, and continues to grow. English teaching and learning in the information age need to be carried out with the help of intelligent system software to change the disadvantages of traditional English teaching as well as learning.[12]
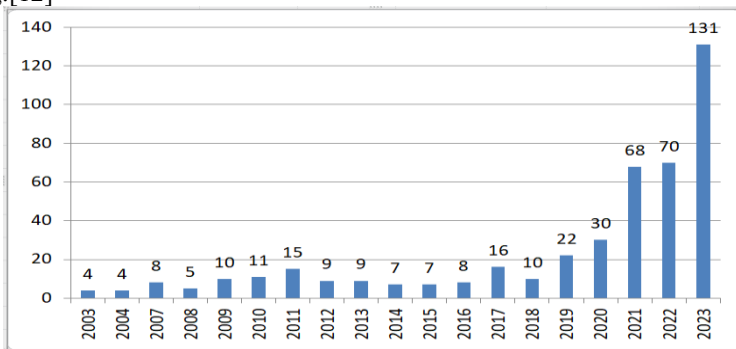

Fig. 1. Statistical distribution of annual number of publications

3.2   Country Distribution

Analysis the country distribution, we get the Figure 2. By using CiteSpace analysis, we found that 49 countries are involved in AI application in English language teaching research between 2003 and 2023. To further analyzed, we found that there are many countries have had a significant impact on AI application in English language teaching research based on the number of countries in which AI is used. In Table 1, we list the countries and their published number. Among that we can find that during the period of 2003 to 2023, the USA has had the most attention in this research with 106 publications, accounting for 20% of the total. It shows that the USA is at the forefront of research in this field. The following countries are China(92), England(76), Chinese Taiwan(47), Australia(34), South Korea(25), Spain(21), Germany(17), Canada(14), Singapore(11),etc. This shows that research on AI in English language teaching requires a certain economic foundation [13], and in countries with better economic development, there are advanced equipment and technological support to lay the foundation for the integration of AI in education [14]. In addition, in some native English-speaking countries such as the United States, the United Kingdom and Australia, English courses are one of the main courses for students to learn, so the use of advanced AI technology to assist English language teaching will be prioritized in the teaching process [15]. For China, South Korea, Germany and other countries that use English as a second language, due to the needs of national development, in order to better communicate with the world, it is very important to master English language [16] which is the world's official language, so with a certain economic base to get support, these countries attach great importance to the development of English language teaching [17], and the research on the application of AI in English language teaching will be more than other countries.

Table 1. Pubilshed number of top 10 countries

Number	Country	Publish Number
1	USA	110
2	PEOPLES R CHINA	93
3	ENGLANG	82
4	CHINESE TAIWAN	47
5	AUSTRALIA	37
6	SOUTH KOREA	25
7	SPAIN	21
8	GERMANY	17
9	CANADA	14
10	SINGAPORE	11

Through the visualization analysis, as in Figure 2, it can be seen that there is a certain cooperation and exchange between these countries, in which the countries led by the United States and China have the most communication and exchange with other countries such as the United Kingdom, Chinese Taiwan, Canada, etc. It shows that the application of AI in English language teaching has a certain value of research internationally, and there is a significance of the research, which makes it possible for the

countries to study how to be able to better use the AI to assist English language teaching [18].

Fig. 2. Country co-occurrence knowledge graph

3.3   Analysis of Research Institution and Authors

In order to gain insight into the sources and provenance of the literature, we conducted a visual analysis of research institutions and authors using CiteSpace. Figure 3 shows the visual analysis of research institutions, from which it can be seen that although there are many research institutions, the cooperation between institutions needs to be strengthened. In addition, normal university and technological university are predominant and all of them are tertiary institutions, with Beijing Normal University, South China Normal University, Education University of Hong Kong, and Nanyang Technology University leading the way. This shows that research on the application of AI in English language teaching needs to be financially viable, especially for practical research, which needs to be supported by a considerable amount of hardware equipment and technical conditions [19].

Education University of Hong Kong (EdUHK)

Chinese University of Hong Kong

Nanyang Technological University & National Institute of Education (NIE) Singapore

Beijing Normal University

National Institute of Education (NIE) Singapore

Carnegie Mellon University

University of Hong Kong

Monash University

South China Normal University

Lingnan University

Nanyang Technological University

Fig. 3. Institution co-occurrence knowledge graph

Figure 4 shows a visual analysis of the study authors, where the connecting lines represent the collaborative relationship between the authors, and the larger font size of the authors shown indicates a higher frequency of occurrence [20]. As can be seen from the figure, although there is a lot of co-operation between the research authors, most of them are co-authors of the same article, and therefore the common discussion and co-operation between researchers from different regions and countries is not realized. In future research, academic groups also need to strengthen academic communication and exchange [21], and jointly promote the application of AI technology in the field of English language teaching [22]. Future English teachers should continue to develop in the integration of teaching resources and the integration of educational technology, and actively adapt to the requirements of English classroom teaching in the age of artificial intelligence [23].
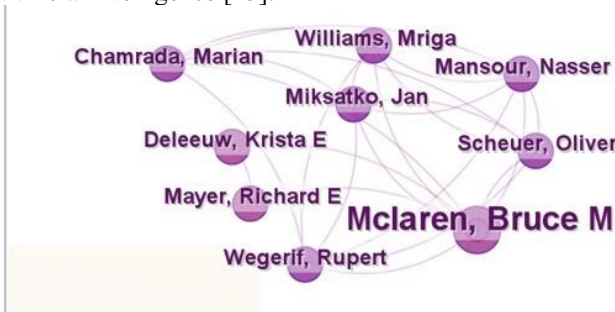
Williams, Mriga

Chamrada, Marian

Mansour, Nasser

Miksatko, Jan

Deleeuw, Krista E

Scheuer, Oliver

Mayer, Richard E

Mclaren, Bruce M

Wegerif, Rupert

Fig. 4. Author co-occurrence knowledge graph

3.4   Analysis of Reseaerch Hotspots

Keywords are the core summary of a dissertation, and analyzing the keywords of a dissertation can give a rough idea of the content and direction of the article's research [24]. The keywords given in the paper must exist in some kind of correlation [25], and this correlation can be indicated by the frequency of co-occurrence [26]. It is generally believed that the more often the keywords appear in the same paper, the closer the thematic relationship between the two topics [27].
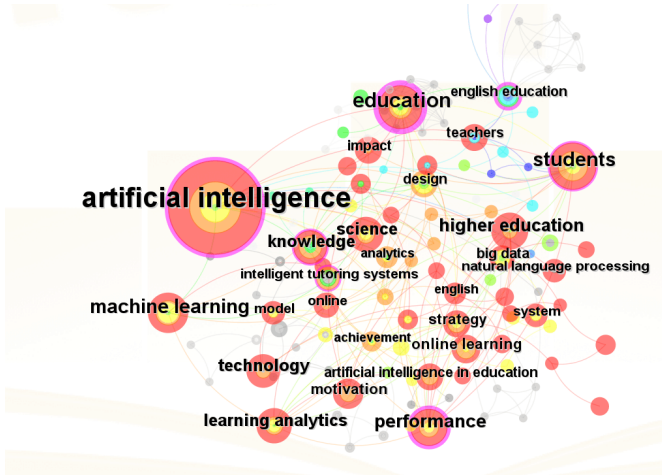
Fig. 5. Keyword co-occurrence knowledge graph

The keywords of 540 documents can be seen by analyzing them through CiteSpace, with a total of 167 nodes, 381 connecting lines, and a network density of (Density)=0.0275, which indicates that the centrality is strong (Figure 5). From the keywords with word frequency over 20(Table2), the top five keywords are Artificial Intelligence (150), Education (42), Students (39), Mache learning (31), Performance (27). And we can also get the high frequency keyword centrality statistics through Table 3. These keywords are all related to each other in some way, for example, there is a strong connection between Artificial intelligence and Education, English, students and so on.

Combining the frequency and centrality of keyword appearances, the research hotspots of AI application in English language teaching can be categorized as follows:

1) Educational theory: the main keywords involved are learning motivation, learning behavior analysis and so on. Students' motivation to learn English is the basis for teachers to use AI-assisted English teaching [28]. Grasping students' motivation to learn and analyzing students' learning behaviors [29] can well assist teachers to find breakthroughs and make better use of AI technology to help students learn English in class as well as out of class [30]. For example, interest is the best teacher, seize the students' interest in learning English [31], using the intelligent oral training platform, through micro-video, micro-animation and other ways to attract students' interest, so that learning English becomes easy and pleasant[32].

Table 2. High frequency keyword frequency statistics

number	keywords	frequency	number	keywords	frequency
1	artificial intelligence	150	11	motivation	14
2	education	42	12	strategy	13
3	students	39	13	online learning	13

4	machine learning	31	14	big data	12
5	performance	27	15	impact	12
6	higher education	22	16	English education	12
7	science	20	17	design	11
8	knowledge	20	18	teachers	11
9	learning analytics	20	19	artificial intelligence in education	10
10	technology	19	20	intelligent tutoring systems	10

2) Information technology: the main keywords involved are Artificial Intelligence, machine learning, big data, technology and so on. It shows that the application of AI in English teaching cannot be separated from the support of information technology [33]. Whether it is the development and application of smart classroom, Mooc [34], or intelligent English learning platform, it is inseparable from the support of big data analysis, machine learning and other technologies. It also shows that such technologies in AI are mainly adopted in the field of English teaching to provide services for education [35].

Table 3. High frequency keyword centrality statistics

number	keywords	centrality	number	keywords	centrality
1	artificial intelligence	0.21	11	motivation	0.01
2	education	0.45	12	strategy	0.09
3	students	0.14	13	online learning	0.04
4	machine learning	0.04	14	big data	0.05
5	performance	0.2	15	impact	0.03
6	higher education	0.09	16	English education	0.23
7	science	0.03	17	design	0.05
8	knowledge	0.18	18	teachers	0.04
9	learning analytics	0.07	19	artificial intelligence in education	0.05
10	technology	0.05	20	intelligent tutoring systems	0.17

3) Typical examples of artificial intelligence technology in teaching and learning aspects: the main keywords involved are online learning, English teaching, intelligence tutoring systems, students and teachers. The combination of theory and practice

is the only way to achieve the purpose of new technology development [36]. By analyzing some examples, such as online education [37] breaks through the boundaries of time and space, and makes more use of network technology and environment to carry out education [38], similarly, English teaching is no exception, and through the way of online teaching [39], more people can learn English at any time and any place, regardless of time and space constraints [40]. By analyzing the reasons why students have difficulties in learning English, such as the fear of speaking English [41], the large number of English grammars that are difficult to distinguish, and the difficulty in accurately mastering the pronunciation of English words, AI technology is used to solve such problems [42]. For example, through the Intelligent Speaking Training Platform, students can practice speaking on their own without worrying about being laughed at for speaking wrongly, and at the same time, they can get timely and accurate correction of their English pronunciation, which can help them master the problem of English pronunciation more quickly [43].

4   Conclusion

In this study, we use CiteSpace to visualize and analyze the literature in the field of AI application in English teaching research in past twenty years, and sort out the research hotspots. Based on above data analysis results, the following conclusions are obtained:

1. From the aspect of the annual publication volume, AI application in English teaching research has divided into two stages: Between 2003 and 2016, research in this area levelled off and not many papers were published; however, from 2016 to the present, research in this area has surged, illustrating the fact that the application of AI in English language teaching is still a research hotspot worthy of researchers to date.

2. From the aspect of countries, institutions and authors, we found that the USA, China, England, Chinese Taiwan, and Australia have published a large number of papers in this field. Meanwhile, Beijing Normal University, Education University of Hong Kong, and South China Normal University have significant impact on this field research. And Mclaren, Bruce M, Williams, and Mriga have strong influence in the research of AI application in English language teaching. What' more, from the institutions' cooperation mapping, it can be seen that the global institutions didn't have closed connection and cooperation which need to be strengthen in the future.

3. From the keyword word frequency and co-occurrence analysis, we divided them into three categories: information technology aspect, education theory aspect, and artificial intelligence technology in teaching application case aspect. The information technology aspect is mainly about the enumeration of artificial intelligence technology, such as machine learning, big data, science and technology, etc. It is the application of these technologies in the teaching of English language, which enhances the effect of English language teaching and effectively assists students to learn English. The educational theory aspect is to explore what is different with the assistance of artificial intelligence technology by analyzing students' learning strategies, learning behaviors, and teachers' teaching behaviors. The aspect of application cases of artifi-

cial intelligence technology in teaching is to prove the current application effect of artificial intelligence technology in English language teaching through some examples. For example, distance education, online education, intelligent English teaching platform, etc. Through these examples, we can learn that AI technology is well used in the classroom of English language teaching, and at the same time, there are some problems that need to be improved.

Overall, artificial intelligence has received attention since its emergence [44]. Combining AI with education can better assist education and teaching. In the research on the application of AI and English teaching, more attention needs to be paid to how these technologies assist English language teaching, what changes teachers need to make to adapt to the development of AI, and how English teaching will change in the future, which is worthy of in-depth thinking and research [45]. This study will also continue to pay attention to these issues in the follow-up, and make exploration and research.

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