Research on the Present Situation of Artificial Intelligence Education Application

Yan Li[✉]

School of Public Administration, Jiangsu Open University, Nanjing, China
`lyan@jsou.edu.cn`

Abstract. [Objective/Significance] Based on the literature analysis of artificial intelligence application research, this paper discusses the integration of artificial intelligence and education, so as to promote the development of artificial intelligence application in education. [Method/Process] Based on the bibliometrics method, taking the Web of Science core set database as the research object, Select the subject "Artificial Intelligence and Education" or "AI and Education" ("AIE" for short) to search, The temporal evolution and spatial distribution of literatures from 1999 to 2019 were systematically analyzed using CiteSpace. [Result/Conclusion] Artificial intelligence and education are independent and integrated with each other. The application of artificial intelligence technology from theory to practice also needs artificial intelligence thinking, technological innovation, participation of teachers and support of relevant policies.

Keywords: Artificial Intelligence · Education · Education data

1 Introduction

Artificial Intelligence (AI) related methods have been applied to various fields in recent years, and gradually become a hot issue in diverse disciplines. Ai development plans of all countries without exception have invested a lot of money to support AI research and talent training, and the pioneers have gone deeper into basic education. In the United States, for example, STEM education has been implemented from kindergarten to high school (K-12) since 2011, and in recent years, it has further developed to a new stage of artificial intelligence education for all. Similarly, in the past two years, the Chinese government has rolled out a series of development plans for AI, including the Next Generation AI Development Plan released by The State Council in July 2017 and the Three-year Action Plan for Promoting the Development of the Next Generation AI Industry (2018–2020) released by the Ministry of Industry and Information Technology in December 2017.On March 5, 2018, the government work report mentioned "intelligence" four times. On April 28, 2018, China's first artificial intelligence elementary textbook was released in Shanghai. 40 high schools across China will offer AI course. These fully reflect the country's determination and action to actively develop ARTIFICIAL intelligence.

What is artificial intelligence? It's hard to identify, even for experts. One reason is that the meaning of ARTIFICIAL intelligence is changing. As Nick Bostrom, a leading

artificial intelligence expert at Oxford University, explains: "A lot of cutting-edge AI has penetrated into general applications and is not usually called AI, because once something becomes useful enough and ubiquitous enough, it's no longer labeled as AI." Instead, it is envisaged a computer program, algorithm or application, but not artificial intelligence. Another reason for the difficulty in defining AI is the interdisciplinary nature of the field. Anthropologists, biologists, computer scientists, linguists, philosophers, psychologists and neuroscientists have all contributed to the field of artificial intelligence, and each group has its point of view and terminology. This paper uses the method of bibliometrics to sort out the literature on "artificial intelligence education" from 1999 to 2019, and presents the definition and application of artificial intelligence education visually, which is of great significance to the reform and development of artificial intelligence education.

The concept of AI was first proposed at the Dartmouth Conference held in the United States in 1956.In short, AI is concerned with developing computer systems that can store knowledge and use it effectively to help resolve problems and complete tasks. Since there is no unified definition, we recommend that AI have at least the following characteristics:

Responsiveness. Artificial intelligence can interact with humans and other machines to interpret meaning and form appropriate responses;

Decisive. AI can interpret the information provided and take appropriate actions to achieve its mandated objectives;

Adaptability. AI can internalize new information and adjust its behavior accordingly to maximize its effectiveness;

Independence. AI can carry out most of the decision-making process without human input.

2   Data and Method

2.1 Data

The WOS Core set database was used as the data source and "Artificial Intelligence and Education" or "AI and Education" (AIE for short) was used as the retrieval subject object. A total of 1148 literatures were selected from 1999 to 2019 (retrieval time: December 3, 2019).

2.2   Research Methods

The selected literature data was imported into CiteSpace, and the parameters were set as follows: the period from 1999 to 2019, the time step was 1 year, the "Keyword" was marked as the node type, the threshold of the analyzed data was set as top N% = 60%, and the final atlas was generated by combining Pathfinder method.

3   Research Status and Analysis

3.1   Time Distribution of AIE Study

The annual publication of AIE and AI from 1999 to 2019 is analyzed in this study, as showed in Fig. 1. As can be seen from Fig. 1, the development of artificial intelligence
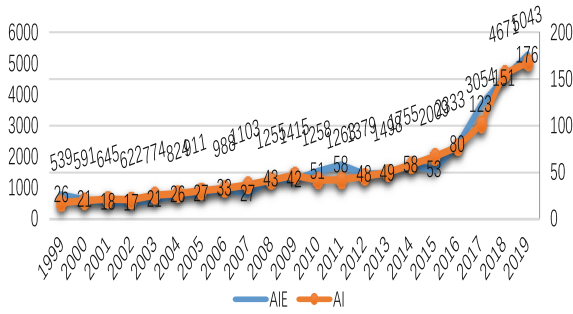
Fig. 1. Literature statistics of AIE and AI studies

and its application research in the field of education are generally on the rise, and the development speed is relatively consistent. As machine learning-related approaches contribute to the maturing of AI technologies, governments are more and more recognizing the value of AI in areas such as economics, energy, transportation, security and education. On the other hand, the advent of the era of big data has brought about changes in education.

From the development trajectory of AIE in the past 20 years, there have been two periods of rapid growth from 2015 to 2017 and from 2018 to 2019, which is also in line with the law of the progress of new affairs. However, AIE studies are relatively rare, accounting for around 3%-5% of the total, without significant growth.

3.2   Spatial Distribution of AIE Research

In order to find out the progress of AIE research in various countries, this study made statistics of the papers published in AIE direction in each country, as showed in Fig. 2. Figure 2 shows that the United States leads by a large margin, indicating that AIE receives prominent attention in the United States. It was followed by Mainland China, the UK, Spain, Canada and other countries that sent similar amounts of documents.

In order to investigate the cooperation between different countries, graduate students developed the AIE Country Cooperation Atlas (Fig. 2). In Fig. 2, each node represents different countries, the node name is the name of the country, the radius of the node depends on the number of published articles, each node ring is used to represent the annual ring, centrality is expressed by the size of the label, and each edge is used to describe institutional cooperation. There are 51 nodes and 110 links in the national cooperation network, while the overall density of the network is only 0.0863, indicating that AIE research groups are scattered, there is less cooperation between authors in different countries, and the research is scattered, and it has not developed into a cohesive and influential research team.

3.3   Analysis of Research Hotspots

In this work, the CiteSpacec operation is carried out to present each node in the form of tree rings for subsequent keyword hotspot analysis. Here, hotspot is given in comprehensive analysis of high frequency words and words with high intermediate centrality
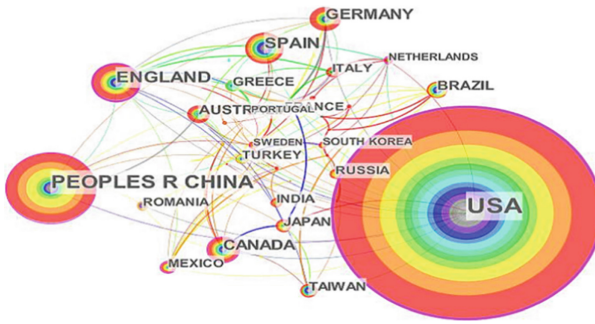
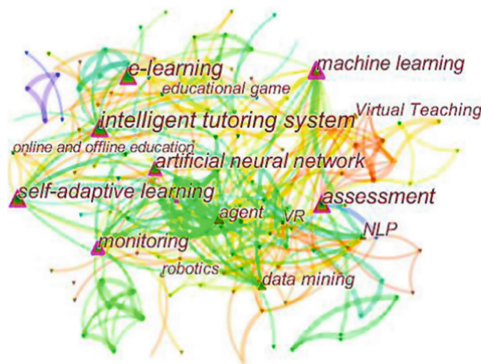**Fig. 2.** Distribution of countries (regions) studied by AIE

Fig. 3. Visualization map of AIE research hotspots

(value higher than 0.1 and purple triangle) [1]. By eliminating basic keywords such as "artificial intelligence", "education" and "higher education", the network knowledge graph of high-frequency and high intermediary centrality keywords was obtained. There are 10 hot keywords in total, showed Fig. 3.

Now the above 10 hot keywords are divided into two aspects:(1) In terms of information technology, it mainly includes "data mining", "virtual reality (VR)", "Agent", "machine learning" and "natural language processing (NLP)". These five keywords correspond to information technology-related methods, which indicates that information technology methods in artificial intelligence provide services for education. ② The application of artificial intelligence core technology in the field of education mainly involves keywords "intelligent tutoring system", "adaptive learning", "online learning", "teaching games", "teaching monitoring", "dynamic evaluation", "education robot", etc.

Generally speaking, the application of ARTIFICIAL intelligence in the field of education can be summarized in the following three aspects:

1. Adaptive learning
   AI provides mechanical support for adaptive learning, allowing students to gain more freedom from spatial location, learning time and learning resources. At the same

time, it also enables teachers to customize personalized learning plans for students depending on their learning interests and hobbies. This will undoubtedly promote a variety of courses and learning styles and increase student choice opportunities. H et al. developed a "Virtual reality demonstration teaching" system (TbDinVR). After an operator demonstrates a task in the virtual world, a robot program is automatically generated to operate in the real world [2]. The education O-M-O mode is a combination of online and offline education, which makes students' learning time more flexible, learning space more accessible, and learning process more targeted, thus improving learning efficiency [3].

2. Intelligent tutoring system

   Mohamed et al. used ITS system to help students learn knowledge outside the classroom in reverse class [4]. Franceska Xhakaj et al. designed an ITS virtual dashboard to analyze students' learning process [5]. Based on the real data of 17 classes in 5 middle schools, the results show that the use of ITS dashboard can influence teachers' knowledge, decision-making and teaching behavior in class.

   Thymio II, developed by ecole Polytechnique Federale de Lausanne (ECole Polytechnique Federale de Lausanne), is a low-cost robot designed to teach children from the age of six and up. Takeshi Morita et al. developed an integrated intelligent application development platform -- Practical Intelligent Applications (PRINTEPS) based on the ontology and rule base of the flat test system to help teacher robots collaborate. When students' learning progress is monitored, learning content suitable for each student's understanding level is presented to support teaching and promote students' active learning [6].

3. Smart evaluation

   Teaching evaluation is a test of teaching effect, not only a judgment of students' learning situation, but also an effective channel to promote students' long-term development.. Eagle et al. inserted the individual parameters of students into the traditional Bayesian knowledge tracking model, and then the individual differences in learning and performance in the intelligent teaching system could be predicted through the data of student activities [7].

3.4 Research Frontier Analysis

In order to obtain AIE research hotspots and cited historical curves, the change of emergent words in AIE research was obtained based on CiteSpace correlation analysis, as showed in Fig. 4. Research hotspots of AIE are mainly reflected in five aspects: intelligent tutoring system (2000–2009), AI (2001–2005), online education (2007–2008), expert system (2015) and visual teaching (2015–2016).

Top 5 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	1999 - 2018
intelligent tutoring system	1999	3.1038	2000	2009	
AI	1999	12.2264	2001	2005	
e-learning	1999	4.81	2007	2008	
expert system	1999	4.6049	2013	2015	
Virtual Teaching	1999	3.0526	2015	2016	

Fig. 4. AIE keyword emergence rate (the figure is from Citespace software)

4   Conclusion

After the text edit has been completed, the paper is ready for the template. Duplicate the template file by using the Save As command, and use the naming convention prescribed by your conference for the name of your paper. In this newly created file, highlight all of the contents and import your prepared text file. You are now ready to style your paper; use the scroll down window on the left of the MS Word Formatting toolbar.

Through CiteSpace, this study analyzed AIE research data from 1999 to 2019 in WOS core set database, and drew the following conclusions:

The time distribution spectrum shows that the overall development of AIE is on the rise, which is basically consistent with the development trajectory of AI literature research. It got in the stage of rapid development from 2007 to 2011 and from 2015 to 2017, and has attracted wide attention. However, the number of AIE related research results is small, and more interdisciplinary researchers are expected to actively give attention to and participate in it.

The spatial distribution map shows that 22 countries (nearly 1/9) participate in AIE research, which is relatively small, indicating that AIE research has not been popularized worldwide. Among the countries involved in AIE research, the United States, as the representative, is well ahead of other countries in its research results. AIE research in the United States started earlier and has now entered the stage of application research and exploration, while other countries mostly stay in the theoretical exploration and embryonic stage. The main reasons are a direct result of the development degree of AI and education policies in various countries. In the future, it will be necessary to strengthen international cooperation, base on domestic educational resources and keep up with cutting-edge research, so as to form a benign mechanism for AIE's development.

The co-occurrence atlas of keywords shows that the hot spots of AIE research are "data mining", "virtual reality (VR)", "Agent", "intelligent tutoring system" and "online learning". However, there is not any close relationship between these keywords and the density is low. In the future, AIE research will need to constantly strengthen the connection between various research fields and form a close research center.

The time sequence diagram of the research frontier indicates that the research frontier of AIE is embodied in the fields of "intelligent tutoring system", "AI", "online education", "expert system" and "visual teaching". The sequence map also reflects that AIE's research topics are constantly exploring new fields, including education management and teaching. However, there are comparatively few studies on enrollment and evaluation of education. In the future, new research topics will need to be constantly developed to integrate AI technology with all aspects of education. Acknowledgments.

References

1. Liu Yong, Sheng Xiaoting, Li Qing.Visual analysis of the application of artificial intelligence in Education in China. Modern Education Technology,2018,28(10):28-35.
2. Onda H, Kitagaki K, Suehiro T. Visualization and simulation of sensory events as a representation of states for state-based teaching by demonstration in VR// International Conference on Intelligent Robots & Systems. 2005.\
3. CAI Lianyu, Han Qianqian. Research on the integration of artificial intelligence and education: a programmatic exploration. E-education research, 2018, 39(10):29–34.
4. Mohamed H, Lamia M. Implementing flipped classroom that used an intelligent tutoring system into learning process. Computers & Education, 2018: S0360131518301118.
5. Franceska Xhakaj, Aleven V, Mclaren B M. Effects of a Teacher Dashboard for an Intelligent Tutoring System on Teacher Knowledge, Lesson Planning, Lessons and Student Learning// European Conference on Technology Enhanced Learning. Springer, Cham, 2017.
6. Takeshi M, Shunsuke A, Chihiro N, A Practical Teacher -- Robot Collaboration Lesson Application Based on PRINTEPS. The Review of Socionet work Strategies, 2018, 12(1):97-126.
7. Eagle M, Corbett A, Stamper J, etc. Estimating individual differences for student modeling in intelligent tutors from reading and pretest data. Springer International Publishing: International Conference on Intelligent Tutoring Systems, 2016: 133–143.