[1]Zaifeng Yang
[2]Shixiong Li
[3,*]Yanting Pan

Analysis of Artificial Intelligence in International Higher Education Field Based on Bibliometrics

Journal of Electrical Systems

Abstract: - Artificial intelligence (AI), as a significant feature of modern development, has changed the form of education, especially with a significant impact on higher education (HE). Clarifying the integration and infiltration of HE and AI is of great significance for the future development of AI in HE. The Citespace is used to make a quantitative and qualitative analysis of the indicators such as authors, institutions, nationalities, disciplines, journals, and highly cited articles of AI research literature -located at HE included in the Web of Science core collection database. The results show that in recent years, AI in the field of HE has received extensive international attention, and the research results are in a growing trend. In the field of international HE, AI focuses on hot topics such as parameter design, deep learning, machine learning human-computer interaction and hybrid learning. And deep learning, learning space simulation design, learning effectiveness measurement, etc. will become an important development direction of international AI research in the field of HE.

Keywords: Artificial Intelligence, International, Higher Education, Metrological Analysis.

I. INTRODUCTION

The artificial intelligence (AI) refers to the intelligence shown by machines that can perform complex tasks of human intelligence. As an innovative technology, AI will become a typical hard trend in the future. [1] In order to adapt to social customs in the twenty-first century AI, the reform and development of higher education (HE) in various countries is imperative. As S. Adams Becker et al. wrote in the 《Horizon Report》, it can be predicted that AI will be widely implemented in the field of HE in the next four to five years. [2] In order to promote HE and other fields to adapt to this change, in recent years, governments around the world have successively issued various policy documents related to the research and development of AI, such as the United States first issued the National Strategic Plan for Research and Development of AI in 2016, and the United Kingdom, France, Germany, Japan and South Korea successively issued their own strategic policies for the progression of AI in 2018. China attaches great importance to the research and development of AI technology. In 2017, China issued the Development Plan for a New Generation of Artificial Intelligence, and in 2018, issued the Action Plan for Artificial Intelligence Innovation in Colleges and Universities, In his congratulatory speech to the International Conference on Artificial Intelligence and Education in 2019, pointed out that "education should take cultivating a large number of high-end AI talents with innovative ability and cooperative spirit as its important mission, and China will actively promote the deep integration of AI and education". The purpose of the above-mentioned national initiatives shows that the promotion of AI in the field of HE has been in full swing in recent years, and the rapid development of AI needs the support of relevant theories. Understanding the current situation of AI research in the field of international HE has an important enlightening effect on the theoretical research of the deep integration and development of China's HE and artificial think tanks.

II. LITERATURE REVIEW

Since the middle of last century, scholars have begun to search for various theoretical knowledge related to AI. In 1956, John McCarthy studied the relationship between AI features and learning. [3] In addition, around the new century, Frasson (1990), Vladan, Deved žić (2004), Macukow (2006), Cumming (2008), Dimitrova (2009) and other scholars also actively discussed the close relationship between AI and HE. In recent years, as AI has been highly valued by governments of all countries and promoted to be an important part of national development strategies, AI and HE topics are favored by scholars of all countries. Tastimur, Canan (2016) believed that AI would help improve the validity and accuracy of HE quality evaluation [4]. Ozbey, Nigar (2017) believed that AI can provide useful help for HE to solve some complex problems, and analyzed the factors that AI affects college

[1] School of Teacher Education, Wuzhou University, Wuzhou 543002, China; GongQing Institute Of Science and Technology, GongQing 332020, China
[2] School of Mechanical and Resource Engineering, Wuzhou University, Wuzhou 543002, China
[3] School of Teacher Education, Wuzhou University, Wuzhou 543002, China
*Corresponding author: Yanting Pan

students' learning and identification process [5]. Salgado (2017) dynamically analyzed the changes of scientific management of HE in the era of AI based on ontology and the ecosystem of intelligent tools. [6] León and Vi (2017) believed that the application of AI in HE could be beneficial to students' personalized education by managing the automation of teaching tasks [7]. Ciolacu, Monica (2018) discussed the process of AI assisted HE based on Education 4.0, and students' wearable devices used intelligent sensors to adjust their learning effects.[8] Hinojo Lucena (2019) compared WOS and Scopus (2007-2017) databases on AI output and other indicators in the field of HE.[9] Altinay (2019) believed that HE AI courses usually include machine learning, human-computer dialogue, data science and other interdisciplinary knowledge.[10] Also, Wim Westera, Ishrat Ahmed, A Mitrovic and other scholars have conducted research on the latest application of AI in the field of HE.

The author conducted an advanced search on How Net under the title of HE and AI. Currently, only 47 research articles have integrated the two. Zhang Congpin and Shi Xiaobo (2009) first published the Research on the Teaching Reform of Artificial Intelligence in Adult HE in China Adult Education. In recent years, the research on AI in the field of HE has attention drawn to domestic scholars. Liu Ning (2018) discussed the changes that AI has brought to HE. Duan Shifei and Zhang Wei (2019) discussed the reform of British HE in the era of AI. Liu Jin and Lv Wenjing (2019) discussed the countermeasures for China's HE in the era of AI. Zhao Bin, Huang Tianyuan (2019) and Yuan Guanglin (2019) discussed the reform of HE in the era of AI. Su Ming et al. (2019) analyzed the co evolution of AI and HE. Zhao Yuan (2019) analyzed the choice of HE in the era of AI. In general, domestic research on AI theory in the field of HE still lags behind the actual development needs.

There is no doubt that since AI was proposed in the 1950s, scholars have made fruitful achievements in various researches on the connection between AI and HE. International research on AI in the field of HE can provide theoretical guidance for guiding the reform of HE in the era of AI. The objective and scientific analysis of the existing research achievements in the field of AI application in HE in the world, and the understanding of its historical evolution and characteristics of the times, will undoubtedly have a mirror value for China to review the trend of AI research in the field of HE in the future.

This paper takes "Web of Science core collection database" (hereinafter referred to as "WOS core collection database") as the sample source. Search the WOS core collection database with the theme of "Artificial Intelligence" and "Higher Education". The time span is set as 2000-2020. The search date was January 2020. The search showed that there were 230 entries in total. After removing some irrelevant data, 212 entries were valid. The 212 titles are exported. The exported records are full records and references cited. The file format is plain text. The obtained text is used as the sample for this study.

This paper uses Citespace software 5.3 as a research tool. It has developed by Dr. Chen Chaomei, an American Chinese, which is used to identify and demonstrate new trends and new developments in science in scientific literature. This software can find out the pioneering and landmark literature in a certain research field for massive data mining, identify themes that are dominant across the field of study and identify close links between different research themes, building on a certain knowledge base, study how the frontier evolves. Import the research samples into Citespace, set various selection criteria, and make statistics on the authors, institutions, nationalities, disciplines, cited words, etc., combining with the statistical results for further in-depth analysis.

III. Research Results and Analysis

A. Outline of AI Research in International HE

The research progress of AI in the field of international HE can be understood and scientific basis can be provided for predicting the future development through the distribution of literature output years.

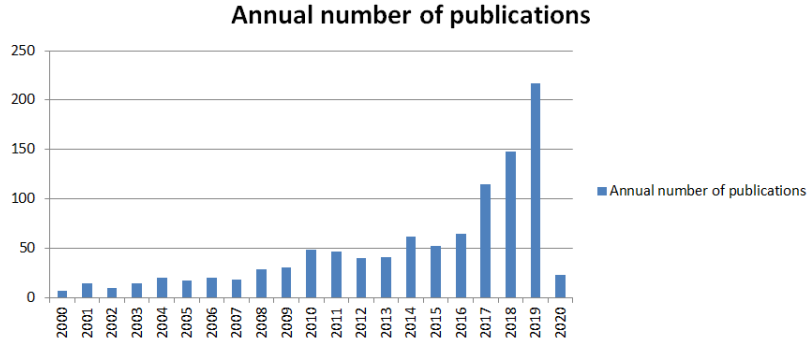

Figure 1: WOS Core Collection Database Published in the Field Of AI in International HE in Each Year

The results (Figure 1) show that from 2000 to 2020 years, the number of articles published in the WOS core collection database in the field of international HE in the field of AI research has decreased slightly compared with the previous year in a few years, such as 2002 and 2005, but the number of articles published in the overall trend of growth. In terms of time period, there were few AI researches in the field of HE in the WOS core collection database in the world from 2000 to 2008. In 2000, the number of papers published in the WOS core collection database was zero, and in 2002, 2006 and 2007, there was only one. During this period, the total number of papers published in the WOS core collection database was 16, accounting for 7.55% of the total. After 2009, the research literature on AI in the HE field of the WOS core collection database gradually increased. In 2010, there was a small peak. The number of papers issued in that year was 15, accounting for 7.08% of the total. Since 2013, the number of papers issued by the WOS core collection database on AI in the HE field has steadily increased year by year. In 2019, the number of documents issued reached the peak of 47, accounting for 22.17% of the total number of documents issued. In 2020, the data is less, and the main retrieval time is the beginning of the year. As an important international database, the WOS core collection database can be seen from the law of changes in the number of articles in each year. Combined with the current AI, it is highly valued by countries around the world. It can be predicted that the number of papers related to the research of artificial think tanks in the field of international HE will continue to grow in the future.

Currently, most countries want to take the lead in the development of AI, and scholars from different countries actively discuss the topic of the application of artificial think tanks in the field of HE. According to the statistics of the countries where the articles are from, it can be seen more and more national scholars focus on the theoretical research on the integration of AI and HE in recent years.

Table 1: Countries with the Most AI Research in HE Published in WOS Core Collection Database ($n \geq 7$)

No.	Country	Frequency	First issue	No.	Country	Frequency	First issue
1	China	71	2006	10	Russia	11	2005
2	America	62	2000	11	Netherlands	11	2019
3	Spain	28	2010	12	Greece	10	2009
4	Britain	19	2002	13	France	10	2017
5	Germany	17	2009	14	Australia	8	2017
6	Mexico	13	2010	15	Romania	8	2010
7	Brazil	12	2013	16	India	8	2010
8	Canada	11	2013	17	Portugal	7	2015
9	Türkiye	11	2014	—	—	—	—

According to statistics, 212 articles on AI research in HE published in the WOS core database are from 49 countries, among which 9 countries have issued one article. The table 1 shows the countries with more than seven articles. From the table, there are 13 countries with more than ten articles. The China and the United States lead other countries in publishing civilization. The China tops the list with 71 articles, Spain follows China and the United States with 28 articles, and Britain and Germany also have more articles. Judging from the time when the first papers were published in various countries, the United States began to publish relevant articles in 2000, and the United Kingdom also began to publish papers in 2002, indicating that the United States and Britain, as developed countries, had earlier research on AI in the field of HE, reflecting that the United States and Britain, as world powers in HE, led the academic frontier ahead of other countries. The Netherlands, France, Australia and other countries started AI research in the field of HE relatively late, especially the Netherlands. The Netherlands first published in 2019, but 11 articles were published within a year, indicating that the topic of AI in the field of HE is rising in the Netherlands, which is related to the establishment of an AI research alliance in the Netherlands in 2019 and the government's submission of the AI Strategic Action Plan to the parliament, It also reflects that scholars' research topics are driven by government policies.

B. Bibliometric Analysis of AI research in International HE

The following is an analysis of the characteristics of AI research in the field of international HE from such dimensions as subject attributes, authors, institutions, journals, and high citations.

1) Distribution analysis of discipline attributes

Statistics show that at present, there are 71 disciplines involved in AI research in the field of international HE in the WOS core collection database, of which only one related article has appeared in 32 disciplines, accounting for 45.07% of the total disciplines. There are more than 10 relevant articles in 10 sciences, accounting for 14.08% of the total number of disciplines, among which 58 articles are related to education and educational research, which is consistent with the AI research in the field of HE as an important part of the current educational development.

In addition, there are 38 articles related to computer theory methodology, 38 articles related to electrical and electronic engineering, 36 articles related to computer AI, 33 articles related to interdisciplinary application of computer science, 31 articles related to educational science branches, 27 articles related to engineering, 20 articles related to computer information systems, 13 articles related to telecommunications, and 10 articles related to computer software engineering. It can be seen from the scope of disciplines involved in AI research in the field of HE that AI research in the field of HE is not limited to a single discipline knowledge, many of which are interdisciplinary and multidisciplinary. Computers and pedagogy are the most involved articles in AI research in the field of HE internationally, which conforms to the cross combination attribute of HE and AI.

2) High yield author analysis

According to statistics, there are currently 212 AI articles published in the WOS core collection database in the field of HE involving 676 authors from different countries. The maximum number of authors who published one article was 646, accounting for 95.56% of the total number. The total number of authors who published more than two articles was 30, and the maximum number of articles was three. They were respectively from Tsinghua University in China, Romaniuk, Ryszard, Modelski, and Jozef of Warsaw University of Science and Technology in Poland. Among these three people, Romaniuk, Ryszard, Modelski, and Jozef had published relevant papers in 2010, It was only in 2018 that Zhang Jiyuan of Tsinghua University started to publish articles in the WOS core collection database, reflecting that Chinese scholars started late in the research of AI in the field of HE. From the perspective of the author group, the current AI research in the international HE field has not formed a core author group. Among the top 30 authors, 6 are Chinese, which shows that the research on AI in the field of HE in China is rising. In terms of the author's influence, Anonymous, Chen CW and Samant have been cited the most.

3) Analysis of research institutions

According to statistics, 212 articles were written by 321 institutions. From the perspective of institutional contribution, the majority of institutions contribute one article, 65 institutions publish more than two articles, and 14 institutions publish more than three articles. Among them, Huazhong University of Science and Technology and Chinese Academy of Sciences both have 5 papers, which is the largest number of papers. Tsinghua University, European Business School, Valencia University of Technology, University of British Columbia and other four universities are closely followed by 4 papers. From the nature of academic contribution institutions, it can be seen that the research on AI application in HE mainly comes from universities in various countries. Compared with other countries, universities in China are more dynamic. The number of papers issued by well-known universities in China, such as Huazhong University of Science and Technology and Chinese Academy of Sciences, is ahead of other foreign universities. This shows that in recent years, the country has attached great importance to the development opportunity of artificial think tanks. Some domestic scholars have actively carried out research on the topic of artificial think tanks in the field of HE, and provided academic theoretical support for the development of AI in China.

4) Analysis of main journals

In general, leading the academic frontier is the core tenet of the development of international journals. With the development of information and communication technology, AI has become a modern high-frequency word. At present, AI is an important hot topic in the field of HE at home and abroad. Through the statistics of the number of papers published in the issue, we can know which international journals currently focus on AI research in the field of HE. Statistics show that these 212 articles come from 101 journals or conference collections, including 53 journals with 1 article. Table 2 shows the journals or collections with more than 3 articles. From the statistical results, engineering, advances in intelligent systems and computing, inted proceedings, advances in social science education and humanities research, edulearn proceedings, elearing and software for education and other six issues have the largest number of papers, with a total number of 40 papers, accounting for 18.87% of the total number of papers. There are 11 periodicals with more than 3 articles, accounting for 15.57% of the total number of articles published. Most of the more than three journals published on AI in HE are related to computers or education. These journals have played a leading role in AI research in HE, indicating that these journals have taken AI research in HE as an important topic in recent years. From the statistics of the cited journals, five journals, including Lect notes comtutsc, expert systappl, prothet orthotint, jvib control, and psocphotooptins, have been cited more than 40 times in this field in recent years, indicating that the AI research articles in the field of HE published in these journals are of high academic value.

5) Analysis of highly cited literatures

Citation frequency is the most intuitive indicator to measure the academic influence of articles. Generally speaking, whether the article is cited reflects the academic influence of the article. The more frequently the article

is cited by peers, the greater the academic value of the article. The Table 2 shows some highly cited articles on artificial think tanks in the field of HE in the WOS core collection database in recent years.

Table 2: The Most Cited Articles of AI Research in HE Field of WOS Core Collection Database (N ≥ 20)

Thesis Title	First author	Source	Year	Institution (country)	Frequency
Heading to ward AI 2.0	Pan Yunhe	ENGINEERING	2016	Chinese Academy of Engineering (China)	47
Evaluating the effectiveness of educational data mining techniques for early prediction of students' academic failure in introductory programming courses	Evandro B.Costa	Computers in Human Behavior	2017	Federal University of Aragos (Brazil)	37
Polite web-based intelligent tutors: Can they improve learning in classrooms?	McLaren	COMPUTERS & EDUCATION	2011	Carnegie Mellon University	36
Siri, Siri, in my hand: Who's the fairest in the land? On the interpretations, illustrations, and implications of ai	Kaplan Andreas	BUSINESS HORIZONS	2019	European Business School (Germany)	34
Prediction of student's mood during an online test using formula-based and neural network-based method	Moridis	COMPUTERS & EDUCATION	2009	University of Macedonia (Greece)	31
Toward New-Generation Intelligent Manufacturing	Zhou Ji	ENGINEERING	2018	Huazhong University of Science and Technology (China)	31
AI in histopathology - from image analysis to automated diagnosis	Kayser, Klaus	FOLIAHISTOCHEMICAET CYTOBIOLOGICA	2009	Charlotte Medical University Berlin (Germany)	27
Good wine may need to mature: a critique of accelerated higher specialist training. Evidence from cognitive neuroscience	Talbot, M	MEDICAL EDUCATION	2004	Sheffield University (UK)	23
An enhanced Bayesian model to detect students' learning styles in Web-based courses	Garcia, P	JOURNAL OF COMPUTER ASSISTED LEARNING	2008	University of Buenos Aires (Argentina)	20
Strategies and Principles of Distributed Machine Learning on Big Data	Xing, Eric P	ENGINEERING	2016	Carnegie Mellon University(United States)	20

Table 2 show that the Heading toward Artificial Intelligence 2.0 published by Pan Yun HE of the Chinese Academy of Engineering in the journal ENGINEERING in 2016 is the highest cited article at present, which has been cited more than twice a year on average. In addition, evaluating the effectiveness of educational data mining techniques in early prediction of student academic failure in product programming courses by Evanro B. Costa of the Federal University of Aragos, and Political web based intelligent tutors: Can they improve learning in classrooms? By McLaren of Carnegie Mellon University the articles such as "Siri, Siri, in my hand: Who's the fastest in the land? On the interpretations, illustrations, and implications of artistic intelligence" by Kaplan Andreas, a European Business School, have been cited many times by peers, reflecting that these articles have great influence among international peers. From the perspective of countries, articles published by scholars from China, the United States, Germany, Brazil and other countries have been cited most frequently by peers, which indicates that the AI research in HE in these countries has been recognized by international peers.

C. Analysis of AI Research Topics in International HE

1) Analysis of AI research hotspots in international HE

Generally speaking, the key words are the soul of the article, reflecting the theme of the article. The key words highlight the content characteristics of the article. Quantitative analysis cannot be separated from the statistical analysis of keywords. The statistics of keyword discovery can find out the topics and potential interrelationships of AI research in the field of international HE in recent years from their frequency and time of occurrence. Statistics show that there are 994 keywords in 212 AI articles in the field of international HE, many of which only appear

once or twice, and 82 keywords appear more than three times. The Table 3 shows some frequently occurring keywords in AI research articles in the field of international HE.

Table 3: High Frequency Keywords of AI Research Articles in International HE Field (N ≥ 4)

Core terms	Frequency	Centrality	Core terms	Frequency	Centrality
Artificial intelligence	69	0.59	Mooc	5	0.00
Education	30	0.47	Game	5	0.06
Higher education	21	0.37	Robotics	5	0.00
Machine learning	15	1.20	Deep learning	5	0.11
System	12	0.00	Technology	5	0.23
learning	10	0.08	Internet	5	0.13
Neural network	8	0.32	Performance	5	0.00
Model	8	0.00	Expert system	4	0.01
Design	8	0.00	Student	4	0.00
Artificial neural network	7	0.23	Natural language processing	4	0.00
Big data	7	0.21	Assessment	4	0.12
Prediction	7	0.40	Data mining	4	0.00
Network	7	0.00	Classification	4	1.34
Future	7	0.12	Quality	4	0.12
Genetic algorithm	6	0.23	Evolutionary algorithm	4	0.29
Fuzzy logic	6	0.00	Selection	4	0.38

It can be seen from the Table 3 that there are 32 keywords with more than 4 occurrences, among which AI has the most occurrences, up to 69, with a centrality of 0.59, followed by education, HE and machine learning, with a centrality of 1.20, reflecting its status and influence in key words. Combined with high-frequency terms and high school mentality analysis, it can be concluded that the research on AI in the international HE field from 2000 to 2020 falls into the following categories: the first cluster consists of core terms such as system, big data, network, robot, technology and the Internet. This topic clarifies the conditions required for the application of AI in the field of HE. The second cluster consists of such core terms as Moke, game, evaluation, quality and monitoring. As the carrier of education implementation, what kind of curriculum form and quality can meet the needs of AI development in HE. The third cluster consists of such core terms as classification, selection, students, online learning, machine learning, etc. This topic explains that the application of AI in HE should adapt to the situation and meet the individualized education needs of students. The fourth cluster is composed of core terms such as circular computing, fuzzy logic, deductive algorithm, natural language processing, expert system, etc. This topic clarifies the application of AI in HE system programming. The fifth cluster is composed of core terms such as model, design, neural network and artificial neural network. This theme explains that the application mode of AI in HE needs to formulate a scientific and reasonable assumption.

2) Analysis of AI research trend in international HE

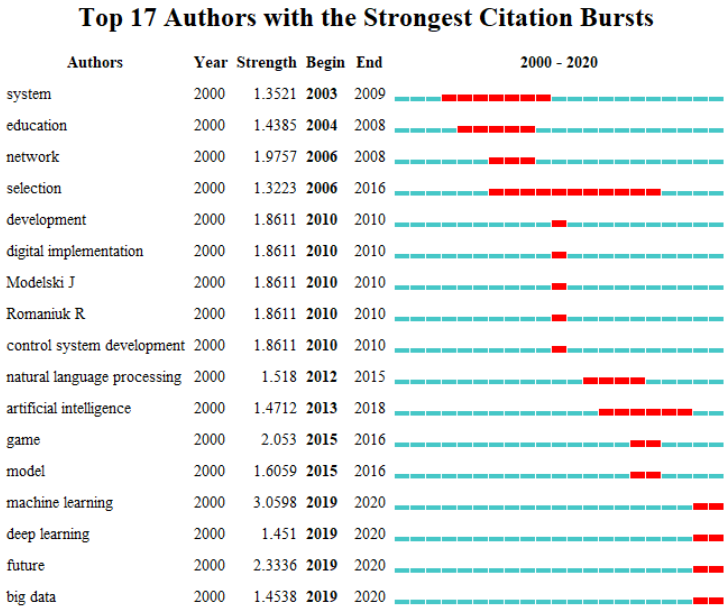

Figure 2: The Changing Theme of AI Research in International HE

Figure 2 shows the salient changes of AI research topics in the field of international education in recent years. According to the change rule of high-frequency keywords, AI research in international HE initially focused on topics such as AI, education, systems and science. With the time going forward and the development of AI technology, the focus of AI research in international HE is also changing. Figure 2 shows that keywords such as system, selection and AI have been concerned for a long time, while terms such as machine learning, deep learning, the future, big data, etc. are the latest to emerge in 2019, with machine learning reaching 3.0598, and future, deep learning, big data, etc.

IV. DISCUSSION

A. Research on AI Parameter Design in the Field of HE

The design of internal program parameters of intelligent machines is the core technology of AI. The design of AI parameters in the field of HE is complex and diverse. Elif and Semra Boran divide the parameter design of human intelligence into three categories: neural network, genetic algorithm and fuzzy c-means algorithm according to the attribute of HE objectives. [11] The data of HE is complex and diverse. In order to reduce the data dimension, it is necessary to fuse multidimensional data into a useful factor and retain the information contained in the original variables. MLA Kaur proposed a new time series algorithm, which uses the weighted average of the minimum variation sequence to aggregate the values of multidimensional data into a single attribute. On the basis of this model, data fusion is achieved by using neural network hybrid fuzzy inference and fuzzy c-means clustering.[12] Abdulshahed is an intelligent compensation system based on camera data thermal imaging to reduce thermal errors of large machines. Based on grey model and fuzzy c-means clustering method, a new method between them is proposed. A machine thermodynamic prediction model was designed by fuzzy c-means clustering adaptive neuro-fuzzy inference system. [13] With the increase of information sources in universities, there is a need to improve the reliability and efficiency of system measurements, and to process complex data using aggregation algorithms. Intelligent systems must analyse large datasets, thus placing high demands on the implementation of new processing algorithms. The programme is further accountable for the collection of data, transformations, pattern searching and decision making. [14] In addition, some scholars use the structured method of fuzzy Delphi method to compare the evaluation results in the fuzzy analytic hierarchy process fuzzy goal programming with the performance indicators such as mean square error, mean square error, normalized per capita error, average absolute error, normalized per capita error, and minimum absolute error.

B. Research on AI Deep Learning in HE

The deep learning of AI in the field of HE is different from autonomous lifelong learning. Deep learning means that students master the learning content through critical thinking, problem solving, mutual cooperation and independent learning. The deep learning method has made great progress in the application of AI in the field of HE, but at the same time, new problems are constantly emerging. There is still a long way to go from the goal of HE students' learning.[15] In the field of HE, AI deep learning aims to keep students motivated all the time, allowing students to understand the connection between the curriculum and the real world, and the impact of new knowledge and skills on their future. The application of AI in the field of HE deep learning, project-based learning, challenge-based learning, inquiry-based learning and other similar approaches can help students to have a more active learning experience [16]. Deep trust network, automatic encoder and deep convolution neural network are used in the field of AI in HE [17]. In the face of new problems emerging in the depth learning of HE, AI also needs to be constantly improved.

C. Research on AI Machine Learning in HE

Machine learning algorithm can automatically search the very complex relationship between a large number of input data. In the past, traditional machine learning technologies needed to design learning features to represent the running process before the course.[18] The emergence of graphics processing unit software has solved and improved the long-standing problems of AI machine learning series.[19] Developing an automatic knowledge extraction, synthesis, interpretation and evaluation system based on AI and machine learning will help to change human behavior.[20] Human beings are increasingly exposed to AI and machine learning systems. Human centered AI is a viewpoint about AI and machine learning. When designing algorithms, we must realize that human is a part of the system. That is, human centered AI can be divided into two aspects: AI systems understand human beings from the perspective of social culture; AI systems help people understand people [21].

D. Research on AI Human-computer Interaction in HE

Human computer interaction emotion detection has become an important field of student modeling, and considerable progress has been made in developing effective models. Many successful models use physical and physiological sensors for this task. The example of "sensorless" affects the detectors that only evaluate students based on the interactive data between students and computer-based learning platforms, but these detectors are often difficult to justify their use in real-time interventions. AI in the field of HE is a student centered human-computer interaction mode. A stronger synergy should be established between designing e-learning experiences and analyzing the interaction between learners' preferences and e-learning environments. The theory and method of human-computer interaction can support the design of an appropriate e-learning environment to meet the complex and rapidly changing needs. In this work, we need to build a new "depth" sensor free impact detector.[22] In the past, human-computer interactive learning communities mainly focused on studying the technical quality of these systems, ignoring their teaching effectiveness and availability. Therefore, the human-computer interactive learning community needs to design and discuss new standards to design more practical and innovative systems to support creative learning. On the one hand, it can guide learners to make the most effective use of teaching content, on the other hand, it can avoid strategies that interfere too much with the learning process. Imitative learning is that human-computer interaction plays an important role in effectively improving the intelligence of robots and the ability to work with people. The application of AI in HE involves a human-computer interaction experiment in an immersive virtual reality environment. The student is in the focus of a 4m long hemispherical dome projector. By combining the configured data gloves with smart phones, students can directly interact with computer programs/clients.

E. Research on AI Hybrid Learning in HE

AI in the field of HE needs to combine online and offline hybrid learning. Blended learning has emerged as an ever more popular mode of e-learning and is particularly well suited to the transition from traditional learning and teaching to e-learning. This model is a hybrid model based on cooperative learning, problem oriented learning and autonomous learning. The objectives of the blended learning environment include rich teaching content, access to knowledge, social interaction, personal initiative, and cost-effectiveness. The discussion of e-learning and web-based learning focuses on hybrid learning programs, which can include offline and online learning, self-paced and on-site cooperative learning, structured and unstructured learning, customized content and ready-made content [23]. Blended learning combines basic information about novice technology with complex ideas about using technology in the classroom. Teachers can use technology to strengthen and support students' learning and provide practical advice and suggestions. In the 2009-2010 academic year, 17 groups of Granada University participated in a mixed learning experiment with 1431 students. This experimental study shows that using blended learning can effectively reduce dropout rates and improve test scores.

V. CONCLUSION AND PROSPECTS

Through scientific metrological methods, this paper conducts a quantitative and qualitative analysis of the relationship between the status quo of AI research in the international HE field and the thematic hot spots. The results show that the literature on AI research in the international HE field will fluctuate and rise from 2000 to 2020. In the field of advanced education, AI parameter design, AI deep learning in the field of HE, AI machine learning in the field of HE Human computer interaction of AI in the field of HE has become a research focus. It shows that the research on AI in the field of international HE has been highly valued by scholars from all countries and has accumulated fruitful results. In the light of the international research progress and the current situation of the actual development and theoretical research of AI in the field of HE in China, domestic scholars can strengthen the relevant research on AI in the field of HE from the following topics.

The reform and development of HE has always emphasized deep learning. In the past, the concept of deep learning has been constantly integrated into the field of HE, and new problems have emerged. Some studies have shown that deep learning can help improve the graduation rate of students, but at present, deep learning has not been effectively and widely implemented in the implementation of AI in the field of HE. In order to adapt to the deep learning of HE in the era of AI, students are required to form critical thinking, be able to communicate and cooperate with others, actively and independently learn, and constantly master new learning methods rapidly with the change of information technology. With the promotion of the application of AI in the field of HE and the continuous development of deep learning practice and exploration, deep learning will become the trend guiding the development of AI learning in the field of HE in the future. In the past, the research models of HE, AI and deep

learning mainly included "HE+AI" and "HE+deep learning". It is still relatively rare to study relevant theories by effectively combining the three. In the future, more scholars are urgently needed to effectively integrate the three.

In the era of information intelligence, the talent training paradigm of colleges and universities has changed, and the traditional teaching methods need to adapt to the arrival of the era of AI. Many colleges and universities are gradually moving towards the information digital teaching mode, upgrading the school network to make the wireless network cover the whole campus. Traditional teaching methods are gradually moving towards digital information. AI e-learning in colleges and universities is more realistic, and learning scenes are more and more like the real world and social environment of students' daily learning life, which can adapt to students' learning styles, and ensure high standards of accessibility and availability, so that the interaction between learners and the system is as natural and intuitive as possible. A learning space simulation design based on the learner centered design concept that is constantly developing, taking into account the typical learning styles shared by different cultural backgrounds. The future research based on these assumptions can provide valuable results and enlightening ideas for the intersection of human-computer interaction and e-learning. In the interactive teaching process, students occupy the role of learning space simulation center, and teachers become students' learning partners.

AI has been widely used in the field of HE as a new paradigm. In the era of AI, the reform of HE needs to carry out a variety of related information surveys on the learning effect of teachers, students and other different groups, and monitor the quality, effectiveness, diagnosis and learning of the application of AI in the field of HE. Learning effectiveness measurement is to comprehensively monitor students' learning input and output effectiveness. Online learning mode has become the trend of information intelligence era. AI is applied in the field of HE. Teachers need to evaluate, measure and record students' academic preparation, understand students' learning progress, acquire skills of students' learning results and other education needs of students. However, there is still a lack of a comprehensive, evidence-based evaluation and measurement model to ensure the reliability of the teaching system. The training of e-learning oriented researchers and tracking the important direction of e-learning research in the next few years have played an important "driving force" role. It is necessary to construct a suitable model for measuring the application of AI in HE by taking curriculum teaching, testing academic achievements, teacher experience and evaluation methods as decisive factors. These mainly reflect the monitoring of AI practice effect in the field of HE. At the same time, the academic community needs to conduct relevant research on the evaluation feedback and learning satisfaction of college students.

ACKNOWLEDGMENT

This work was supported by the financial support from the research on the planning of philosophy and social sciences in Guangxi, china (no. 20FMZ049), and Guangxi Education Science "13th Five Year Plan" 2019 National Education Research Project (no.2019ZJY083).

REFERENCES

[1] Burrus, D.: Disruption imminent: artificial intelligence. Brand Q. Mag. 27 (2017).

[2] Adams Becker, S., Cummins, M., Davis, A., Freeman, A., Hall Giesinger, C., and Ananthanarayanan V. (2017). NMC Horizon Report: 2017 Higher Education Edition. Austin, Texas: The New Media Consortium.

[3] Russell, SJ, & Norvig, P (2010). Artificial intelligence: a modern approach, (3rd ed). Upper Saddle River: Prentice-Hall.

[4] Tastimur, Canan. Improvement of Relative Accreditation Methods Based on Data Mining and Artificial Intelligence for Higher Education. InternationalConference on Information Technology Based Higher Education and Training, 2016.

[5] Ozbey, Nigar. The Determination and Analysis of Factors Affecting to Student Learning by Artificial Intelligence in Higher Education. International Conference on Information Technology Based Higher Education and Training, 2016.

[6] Salgado-Guerrero, Juan P. CREAMINKA: An Intelligent Ecosystem Based on Ontologies and Artificial Intelligence to Manage Research Processes, Knowledge Generation and Scientific Production in Higher Education. Communications in Computer and Information Science, 2017: 115-129.

[7] León, G.C.; Viña, S.M. La inteligencia artificial en la educación superior. Oportunidades y Amenazas. INNOVA Res. J. 2017, 2, 412–42.

[8] Ciolacu,Monica.Education 4.0-Artificial Intelligence assisted Higher Education: Early recognition System with Machine Learning to support Students' Success. IEEE 24TH INTERNATIONAL SYMPOSIUM FOR DESIGN AND TECHNOLOGY IN ELECTRONIC PACKAGING (SIITME) 2018.

[9] Hinojo-Lucena F J, Aznar-Díaz, Inmaculada, Cáceres-Reche, María-Pilar, et al. Artificial Intelligence in Higher Education: A Bibliometric Study on its Impact in the Scientific Literature. Education Sciences, 2019, 9(1).

[10] Altinay, Fahriye. Developing at a Great Pace: Studies on Artificial Intelligence in Higher Education. NEW TECHNOLOGIES AND REDESIGNING LEARNING SPACES, VOL II, 2019.

[11] sen, Elif, Boran S. A Novel Approach Based on Combining ANFIS, Genetic Algorithm and Fuzzy c-Means Methods for Multiple Criteria Inventory Classification. Arabian Journal for Science and Engineering, 2017.
[12] MLA Kaur, Gurbinder, J. Dhar, and R. K. Guha. "Minimal variability OWA operator combining ANFIS and fuzzy c-means for forecasting BSE index." Mathematics and Computers in Simulation 122(2016): 69-80.
[13] Abdulshahed A M, Longstaff A P, Fletcher S, et al. Thermal error modelling of machine tools based on ANFIS with fuzzy c-means clustering using a thermal imaging camera . Applied Mathematical Modelling, 2015, 39(7): 1837-1852.
[14] Psuj, G. Magnetic field multi-sensor transducer for detection ofdefects in steel components. IEEE Trans. Magn.2017, 53, 1–4.
[15] Oudeyer, Pierre-Yves. Autonomous development and learning in artificial intelligence and robotics: Scaling up deep learning to human-like learning. Behavioral and Brain Sciences, 2017, 40: e275.
[16] Becker S A, Cummins M, Davis A, et al. NMC Horizon Report: 2017 Higher Education Edition. Journal of Open Learning, 2017.
[17] Faghih-Roohi, S.; Hajizadeh, S.; Núñez, A.; Babuska, R.; De Schutter, B. Deep convolutional Neural Networks for detection of rail surface defects. In Proceedings of the 2016 International Joint Conference on Neural Networks (IJCNN), Vancouver, BC, Canada, 24–29 July 2016; pp.2584–2589.
[18] Sumit Das. Applications of Artificial Intelligence in Machine Learning: Review and Prospect. International Journal of Computer Applications. 2015/04/2.
[19] Jing, X., Peng, P. & Huang, Z. Analysis of multi-level capital market linkage driven by artificial intelligence and deep learning methods. Soft Comput (2019).
[20] Michie, S., Thomas, J., Johnston, M. et al. The Human Behaviour-Change Project: harnessing the power of artificial intelligence and machine learning for evidence synthesis and interpretation. Implementation Sci 12, 121 (2017).
[21] Mark O. Riedl. Human entered artificial intelligence and machine learning. Human Behavior and Emerging Technologies. 2019/01/01.
[22] Botelho A F, Baker R S, Heffernan N T. Improving Sensor-Free Affect Detection Using Deep Learning// International Conference on Artificial Intelligence in Education. Springer, Cham, 2017.
[23] Qizhi Wang. A review on robot learning and controlling: Imitation learning and human-computer interaction. Control and Decision Conference (CCDC), 2013 25th Chinese 2013/05/01.