

Hot Spot and Development Trend of Adaptive Learning in China Based on CiteSpace Software

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Abstract: This paper mainly uses CiteSpace 6.1.R6 software to take the literature related to "adaptive learning" in CNKI as research samples, draw knowledge map, and analyze the research hotspot and development trend of adaptive learning in China. The results show that in the era of irreversible AI development, the number of studies on adaptive learning is increasing year by year. In recent years, the research topics of adaptive learning are mainly neural network, deep learning, reinforcement learning and artificial intelligence. In general, there are a wide range of research fields involving adaptive learning, especially in education, and the quantity and quality of research continue to improve and reach a peak in recent years. Similarly, the research on this topic has core experts and scholars, but lacks mutual cooperation and no systematic and stable research team. However, in the artificial intelligence environment such as ChatGPT, there is still a lack of empirical research on cultivating students' interest in adaptive learning at various educational stages, which also provides the future development direction for the subsequent research on adaptive learning.

Keywords: Adaptive learning; Research hot spot; Development trend; Visual analysis

1. Introduction

Since the 21st century, the development trend of artificial intelligence has been irreversible, which has profoundly changed our life and changed the world. The development of artificial intelligence has brought huge opportunities for the development of education. The field of education has multi-modal teaching resources, which makes the conditions for adaptive learning more abundant, and "intelligent" adaptive learning will become possible. However, there are many challenges hidden behind a series of opportunities for educational modernization. The emergence of deep learning, machine learning and other educational technologies, as well as the evolution of hybrid and project-based teaching modes, has put forward more requirements for the effective integration of information technology and the field of education. How to give students personalized learning in the digital age has caused many researchers to think deeply. In the 2017 New Media Alliance Horizon project, adaptive learning technology was used as a near-term technology that will be widely adopted in the coming year^[1]. Similarly, in 2018 the Ministry of Education of the university innovation action plan of artificial intelligence notice, points out that education informatization field of vision, to actively guide the universities aimed at the world science and technology, constantly improve the technological innovation in the field of artificial intelligence, talent training and international cooperation and exchange ability, provide strategic support for the development of a new generation of artificial intelligence in China^[2]. Thus, it can be seen that in the era of artificial intelligence, the cultivation and development of students' adaptive learning mode and the promotion of personalized innovative talents with the help of various information technologies have become the need of The Times and the realization of the goal of education as a strong country. For more intuitive, comprehensive and scientific understanding of the adaptive learning research hotspot and development trend, this paper intends to use CiteSpace 6.1.R6 software, retrieve adaptive learning as the theme, the related literature knowledge map visualization analysis and review, can be for the subsequent information about artificial intelligence under the background of adaptive learning further research to provide reference.

2. Research program

2.1. Sample sources

The research sample of this paper is mainly derived from CNKI database, with the theme of "adaptive learning" and "adaptive learning". A total of 3021 journal papers were retrieved, including 19SCI sources, 603EI sources, 1746core journals from Peking University and 247CSSCI sources. In the future, conference papers, news and briefing papers, were manually excluded, and a total of 1990 documents were selected into the CiteSpace6.1. R6software for knowledge graph analysis, and a research sample database was established.

2.2. Research tools and methods

CiteSpace is a knowledge mapping tool developed by Professor Chen Chaomei based on java language. The software is based on the idea of "co-occurrence clustering", based on the co-citation analysis theory and path-finding network algorithm^[3], and the application program has been continuously updated to the latest version of CiteSpace6.1. R6since its rise. CiteSpace This visual analysis software plays an indispensable role in a cademic research at home and abroad, especially to help many scholars who have just entered the academic circle to quickly understand the research status, hot spots and development trend of a research topic, which is a measurement method to optimize the utilization of database resources such as CNKI. Analysis of research results. This study is mainly with the help of powerful CiteSpace6.1.R6software, draw the research on "adaptive learning" knowledge map, through the annual post, journal source, the author keywords, keywords, other content, such as a series of knowledge graph analysis, presents the current "adaptive learning" theme research status, hot spots and its development trend.

The whole process of research is mainly based on educational technology research hot topics, search related literature, read the strong correlation literature, installation and skillfully use CiteSpace6.1. R6, determine the analysis Angle according to the current research basis and research purpose, screening literature in the database and conversion format, the converted literature into CiteSpace6.1.R6drawing visual knowledge map, export map and combined with existing research analysis, the proposal of future research direction in this field. The whole process of this study with the help of CiteSpace6.1. R6software is shown in Figure1.

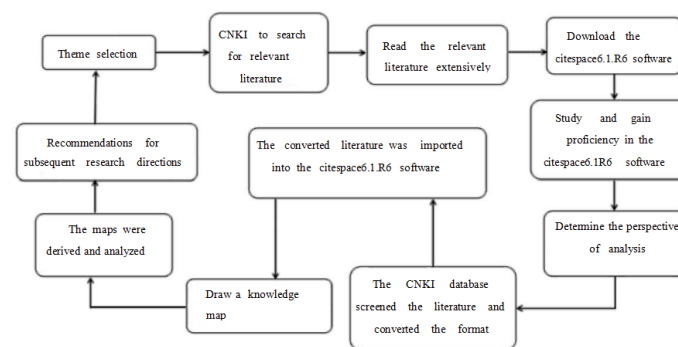


Figure 1: Flow chart of the study

3. Analysis of research results

3.1. Annual publication volume analysis

The annual publication statistics of 1990 journal papers were collected to obtain the time series distribution in Figure2. Through the analysis, the research on adaptive learning in China is deeply influenced by the national policy of cultivating in novative talents. In recent years, due to the rapid development of artificial intelligence, wisdom and education and the pace of education modernization, technology can assign education scientific and systematic increasingly valued, education experts and

scholars gradually strengthen the research on education wisdom, including adaptive learning, deep learning, machine learning and other intelligent teaching mode of in-depth exploration and practice. In 1990, Dai Ju carried out the exploration of the adaptive control method of intelligent robot based on the operation subspace division, combined adaptive learning with the research in the field of intelligent robot, and was a leader in the field of adaptive learning research. In March 2012, the Ministry of Education issued the 10-year Development Plan for Education Informatization (2011-2020), which clearly pointed out that "an informatization should be built environment to provide personalized learning services for each student" and strengthen the training of personalized innovative talents^[4]. Therefore, from 1990 to 2016, the number of publications in adaptive learning journals has been holding a relatively uniform upward development trend. Rapid development from 2016 to 2019, in June 2016, the Ministry of Education issued the education informatization "much starker choices-and graver consequences-in planning" article clearly put forward "network learning space construction should meet the demand of personalized learning, life space, characteristic",^[5] in the use of information can assign teachers' digital teaching and digital learning students should pay special attention to the cultivation of personalized, adaptive learning research wave. Rising trend in 2020 and in 2022 reached the peak of the current research, during the outbreak of "closed without teaching, closed not suspended" education concept to the mass online teaching, teaching interactive decline caused many experts and scholars to explore: how to promote adaptive learning in the digital age "intelligent". From this changing trend, the trend of adaptive learning research is influenced by the policy mechanism that emphasizes personalized quality in the development of national informatization, and the systematic and lasting policy support is the key to the continuous improvement of adaptive learning research.

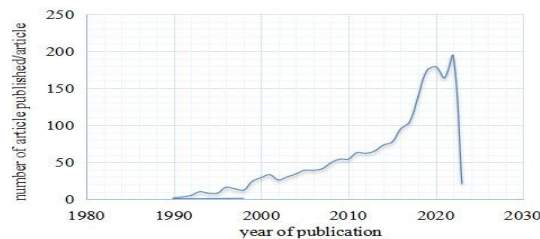


Figure 2: Annual number of adaptive learning journal papers

3.2. Journal source analysis

Select the advanced search of academic journals in the CNKI database, use adaptive learning as the theme, and make the map of the source of articles, as shown in Figure 3.

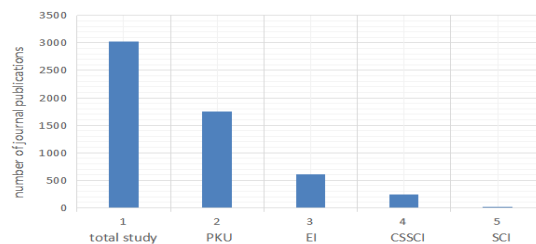


Figure 3: Journal of sources on adaptive learning research

The number of journals retrieved under the theme of "adaptive learning" was 3021, including 19 from SCI sources, 603 from EI sources, 1746 from Peking University core sources and 247 from CSSCI sources. The number of SCI journals accounted for 0.63% of the total number of journals, EI accounted for 19.96%, Peking University core accounted for 57.8%, and CSSCI accounted for 8.18%. Thus, the quality of the current adaptive learning research at a higher level, the domestic many core journals are attaches great importance to the field of adaptive learning, the development in the field of adaptive learning provides a powerful academic support and affirmation, to promote the development of wisdom education to high quality and improve the quality of education teaching is of great significance.

3.3. The author's post volume analysis

Analysis of author collaboration network maps helps to identify core authors or academic groups for research in this field. In this study, 1990 journal papers were introduced using CiteSpace6.1. R6 software

for author knowledge map analysis, as shown in Figure4. The results showed that there were 1676 authors in 1990 papers, including only 1 Zhao Wei with 14 times; only Li Junmin and Sun Yunping for 11 times; 1 Hou Zhongsheng; 9 times only Jiang Qiang; 7 times only 1; 6 times; 1 Wan Haipeng; 5 times; 23 people for 3times; 167; 1466 once, accounting for 87.47% of the total number of authors. Among them, the most prolific author in the field of adaptive learning is Zhao Wei, who has participated in the research of adaptive learning for 14 times as the first author. This shows that although the number of studies on adaptive learning in China is considerable, there are still only a few experts in the field of adaptive learning.

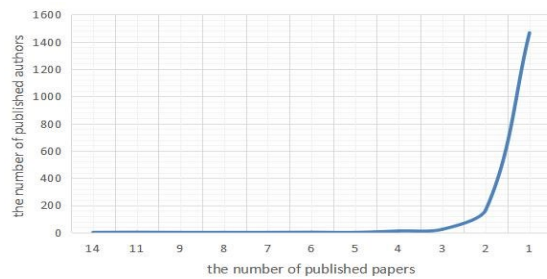


Figure 4: Statistics of the author's publications

In order to further explore whether the research field of adaptive learning has a stable and core research group, this paper maps the author's co-occurrence knowledge with CiteSpace6.1. R6software as shown in Figure5. Among them, there are 851 central nodes, and the network density is 0.0012, which indicates that the overall dispersion of the researchers in the field of adaptive learning is extremely high. The connections in the knowledge graph are all the authors of an article. For example, Jiang Qiang, Zhao Wei and Wang Mingjiao cooperated to complete the adaptive online learning analysis model and implementation article based on personalized big data. Very cooperation among the few high yield researchers. Therefore, the field of adaptive learning research needs to establish a relatively stable research group, to contribute wisdom, and achieve a qualitative leap in this research field.



Figure 5: The authors co-present the knowledge graph

3.4. Research institution analysis

ranking	research institute	frequency	year
1	School of Information Engineering, Zhejiang University of Technology	19	2008
2	School of Science, Xi'dian University	11	2006
3	School of Information Engineering and Automation, Kunming University of Science and Technology	9	2018
4	School of Control Engineering, Naval Academy of Aeronautical Engineering	9	2011
5	School of Online Education, Beijing University of Posts and Telecommunications	9	2008
6	Department of Information Science, Beijing University of Technology	9	2016
7	School of Automation, Nanjing University of Science and Technology	9	2013
8	The University of the Chinese Academy of Sciences	9	2013
9	School of Information, Yunnan Normal University	8	2005
10	School of Computer Science and Information, Northeast Normal University	8	2013

Figure 6: Distribution of research institutions about adaptive learning

Institutional statistics on a certain topic research can quickly understand the core institutions and popularization areas of the current topic. In this paper, the co-occurrence analysis of research institutions

was conducted through CiteSpace6.1.R6 software, and the 10 research institutions with the highest frequency were ranked according to the relevant information, and then the list of high-frequency research institutions about adaptive learning was obtained, as shown in Figure 6.

As can be seen from the analysis data, the top10 institutions in the number of publications are all universities of all kinds in China, among which the top seven universities are all science and technology schools, and the University of Chinese Academy of Sciences, the eighth, is a comprehensive school. More noteworthy is the relevant research of only two normal colleges are from computer college, promote the development of the development of people is the nature of education^[6], adaptive learning as a way of learning and learning form in the field of education, the purpose is to promote the development of students' morality, intelligence and physique, should also become the attention of normal experts and scholars, to adapt to the development trend of digital to explore students' adaptive learning. The above information is enough to show that the main force of research in the field of adaptive learning is the researchers of computer-related majors, and it lacks the active participation of experts and scholars from normal schools.

3.5. Keyword co-occurrence analysis

Key words are the summary and induction of the content of the article. The occurrence frequency of key words can reflect the attention of the research direction, and reflect whether it is a research hot spot in the research field.

Reviewing the journal keywords can clarify the main research direction of this paper, reveal the main content of the paper, and present the trend of thematic research. In order to further understand the current research status of adaptive learning, this paper uses CiteSpace6.1.R6 software to generate a keyword co-occurrence knowledge graph (as shown in Figure 7).



Figure 7: Co-occurrence analysis of keywords in adaptive learning

In order to further verify the reliability and scientificity of the co-occurrence knowledge graph of this keyword, this paper reanalyzed the above keywords with the help of CiteSpace6.1.R6 software, integrated the 20 keywords with the highest frequency, and obtained the list of high-frequency keywords for adaptive learning, as shown in Figure 8.

ranking	keyword	frequency	centrality	year
1	adaptation	223	0.42	1996
2	neural network	119	0.40	1992
3	deep learning	94	0.06	2017
4	reinforcement learning	59	0.10	1998
5	artificial intelligence	50	0.02	1994
6	transfer learning	47	0.02	2014
7	machine learning	45	0.14	2001
8	big data	37	0.02	2013
9	online learning	33	0.05	1997
10	fault diagnosis	28	0.05	2006
11	genetic algorithm	25	0.04	2003
12	manifold learning	23	0.07	2008
13	Study analysis	22	0.01	2013
14	backward learning	21	0.02	2012
15	learning algorithm	21	0.08	1992
16	individualization	20	0.14	2003
17	q study	19	0.01	1999
18	bg algorithm	19	0.06	1996
19	Learning style	18	0.04	2010
20	data mining	18	0.04	2008

Figure 8: Adaptive learning of the high-frequency keyword list

Only the keywords with the centrality value exceeding 0.1 can become the core keywords of the study. The greater the centrality value of the keywords, the stronger the centrality is, indicating that the keywords are more concerned by the researchers. Domestic centrality is more than 0.1 of keywords have

five, respectively is "adaptive", "neural network", "reinforcement learning", "machine learning", "personalized", the adaptive centrality is 0.42, the centrality of neural network is 0.40, reinforcement learning centrality is 0.10, machine learning and personalized centrality is 0.14, that the five nodes plays a key role in the field of adaptive learning, plays an irreplaceable role in the development of the field of adaptive learning.

From the perspective of the years of high-frequency key words appeared in the above high-frequency keywords, most of the high-frequency keywords appeared earlier, among which the most noteworthy is the emergence of the keyword "deep learning" in 2017. The concept of deep learning first came from the paper "The Essential Differences of Learning: Results and Process" jointly published by American scholars Marton and Saljo in 1976^[7]. Here, deep learning mainly refers to the deep understanding of knowledge, which enables learners to broaden their thinking and pay attention to the cultivation of learners' own thinking. Similarly, there is another interpretation of deep learning. In 2006, Professor Hinton of the University of Toronto proposed that deep learning (Deep Learning) is a new technology in machine learning algorithms, which broke the bottleneck of the development of neural networks^[8]. Although there are two different opinions in the academic circle, many researchers have carried out extensive research based on the two interpretations, which has become a major research hotspot in the current development process of educational informatization. In the environment of smart education, schools at all levels and of all kinds have carried out a lot of practice and exploration based on smart classroom, but it is difficult to improve students' core information literacy. One of the major gaps of effective information teaching lies in the lack of "depth" of intelligent classroom teaching practice. As an important path to cultivate students' core literacy, deep learning provides theoretical support and practical guidance for realizing the effective integration of artificial intelligence technology and classroom teaching^[9]. Adaptive learning and deep learning, as a new teaching mode of artificial intelligence education, are closely connected with other modes such as reinforcement learning, transfer learning, online learning and reverse learning. They are all profound embodiment of technology enabling to education and become high-frequency keywords in adaptive learning research. Subsequent research on the field of adaptive learning can also try to carry out in-depth exploration by combining mixed teaching and project-based teaching modes, so as to effectively avoid the "cold storm" brought by the development of artificial intelligence to the field of education.

3.6. Keyword sudden-occurrence analysis

Keyword emergence is a sudden increase or decrease of a number in a certain period; the greater the occurrence value of keyword, the higher the change rate of occurrence frequency^[10]. According to Figure 9, the five keywords of neural network, deep learning, transfer learning, artificial intelligence and learning algorithm have the largest sudden value, indicating that they have attracted high attention and great attention in the research and development of adaptive learning. In recent years, the three prominent keywords with the highest intensity value are deep learning, reinforcement learning and artificial intelligence, which have not disappeared since their appearance.

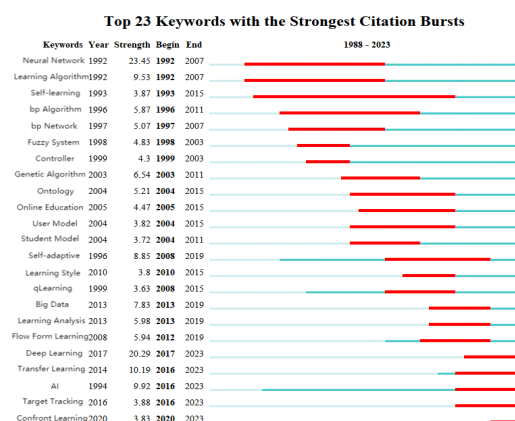


Figure 9: Present analysis of keywords in adaptive learning

Deep learning is the first emerging word. In order to better realize adaptive learning, it is usually necessary to make accurate diagnosis of the cognitive state of learners, so as to match and recommend more suitable learning resources and learning strategies^[11]. Compared with traditional machine learning

techniques, deep learning has better performance in the accuracy and efficiency of cognitive diagnosis. To some extent, deep learning is the accurate understanding and personalized learning of a certain knowledge point under individual information environment learning. Most of the current studies on the combination of "adaptive learning" and "deep learning" are used in medical research, or in the strategic analysis of an algorithm in the field of education. If the research of deep learning is neglected in the development of educational informatization, the integration of artificial intelligence technology and classroom teaching can only be shallow level, and the effective integration of information technology and education and teaching cannot be achieved^[12]. Based on the importance of deep learning, the introduction of deep learning technology in the field of adaptive learning has become an inevitable trend and a proper meaning in the era of education development.

Transfer learning is the second most prominent key word. Transfer learning (Transfer Learning, TL) refers to the learning using data relations acquired in other fields to carry out model training in the absence of sufficient sample data, and the trained model parameters can be transferred to new models to help training. Compared with traditional machine learning methods, transfer learning does not need to rely on massive learner data, and can achieve accurate application in the absence of sample data. Through the transfer learning technology, Jiang Qiang and other scholars have effectively solved the problem that it is difficult to accurately and effectively obtain the corresponding data of learners in the early stage of the course. On the premise of obtaining users' consent, they imported the data from other websites, quickly completed the modeling of learners, and realized the adaptive mixed MOOC mode^[13]. In the cultivation of adaptive learning, the use of transfer learning technology can realize the cross-domain transfer of learners' data and the relative transformation of knowledge structure, and provide more accurate and efficient services for adaptive learning.

Artificial intelligence is the third most prominent key word. Artificial intelligence is the core embodiment of the information age, which is profoundly changing life and innovating education^[14]. Some scholars believe that artificial intelligence has triggered the fourth revolution in education. Artificial intelligence has brought many new perspectives, new ideas and new thinking to teaching. In order to promote the deep integration and continuous development of AI and education, The State Council issued the Plan for the Development of the New Generation of Artificial Intelligence in 2017, and the Ministry of Education issued a series of policy documents such as the Action Plan for AI Innovation in Institutions of Higher Education to guide and guarantee it^[15]. To cultivate personalized learning in lifelong learning with the support of artificial intelligence environment, in the era of wisdom and technology enabling education, learners need to carry out "intelligent" adaptive learning in combination with their own actual situation and their unique value pursuit. Zhou Qin, Wen Xinyue and other scholars have proposed that with the rapid iteration and update of artificial intelligence technology, adaptive learning will be optimized in an all-round way and upgraded to "intelligent adaptive learning"^[16]. Its "intelligent" upgrade can meet the personalized learning needs of learners more scientifically and intelligently, and realize the pursuit of individual value.

3.7. Other content analysis

After the search with "adaptive learning" as the theme, the excel software drew the research field of adaptive learning (Figure 10) and the research chart on adaptive learning in each education stage (as shown in Figure 11).

According to Figure 10, there are 1047 journal papers in the education field, accounting for 34.66% of the total, and 1974 journal papers in other fields, accounting for 64.44% of the total. The number of studies in the educational field is low compared to other research fields, and the importance of adaptive learning topics is far from insufficient. In 2018, in order to strengthen the process of education modernization, realize the realization of the goal of education power, the Ministry of Education issued the education informatization 2.0 action plan, personalized is the inevitable trend of the development of artificial intelligence education application, the cultivation of personalized innovative talents must focus on intelligent learning, adaptive learning and interactive learning. The 2018 Research Report on China Adaptive Learning was released, which elaborated the current situation and main development trend of adaptive learning in the future, and clearly pointed out that the adaptive learning system may become the standard of the education market in the future, and the exploration of adaptive learning plays a vital role in the research and development in the field of education.

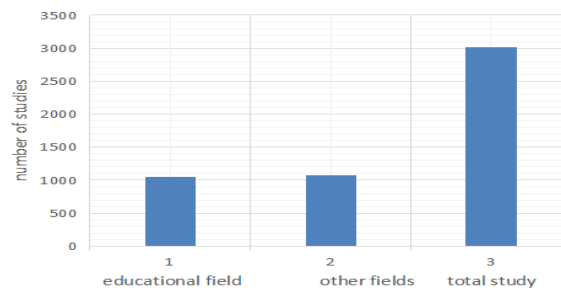


Figure 10: The current status of the research field on adaptive learning

As shown in Figure 11, the status of research in the field of education is different. Among them, there are only 5 studies on adaptive learning in childhood, accounting for 0.48% of the total studies in the field of education; only 2 studies on adaptive learning in secondary school, only 0.19% of the total studies in the field of education; and 33 studies on higher education, accounting for 3.15% of the total number of educational studies. It can be seen that although the study of adaptive learning in higher education is slightly higher than that in basic education, in general, there is a big gap in the study of adaptive learning in each education stage, and the number of studies is far from insufficient.

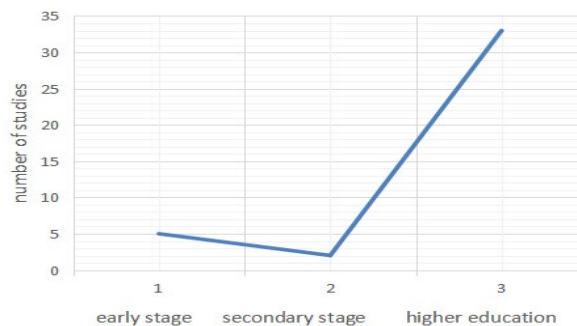


Figure 11: The current status of the research field on adaptive learning

4. Discussion and Suggestions

4.1. System core team building in the field of adaptive learning and research

Promoting the construction of the core research team of adaptive learning is one of the key factors to promote the development of this field. In *The Structure of the Scientific Revolution*, Thomas Kuhn wrote: "In an era of disruptive innovation and development of information technology, crossover and integration, edge and mainstream, personality and diversity, professionalism and crossover, uniqueness and sharing have become the mainstream values identified by knowledge innovators and scientific researchers"^[17]. The research of adaptive learning is not only a problem of education, technology or educational technology. Scholars in various fields should not be immune. People with various disciplinary backgrounds and fields need to participate in the research and form diversified research groups to deal with tests and problems. In addition, various research teams should also organize regular seminars and academic conferences to promote mutual exchanges and cooperation, and promote the in-depth exploration and development in the field of adaptive learning and research.

4.2. Enhance the importance of adaptive learning research in the field of education

After combing the literature, it is found that the importance of adaptive learning in the field of education needs to be improved. With the rapid development of information technology, adaptive learning, as an intelligent learning method, has broad research and application prospects. However, compared with other fields, the research of adaptive learning in education is still lacking, which may be due to the particularity of education and the existence of different disciplines, which leads to higher difficulties and challenges in the construction and application of adaptive learning models. At the same time, the adaptive learning research in the field of education is also restricted by some practical factors, such as learners' privacy protection, lack of educational resources and other problems. Similarly, cultivating learners' core information literacy in the field of adaptive learning is also a major direction

for subsequent scholars to explore. Under the background of the rapid development and innovative education of high and new technologies such as artificial intelligence and educational big data, it is necessary to adapt to the tide of the development of The Times, actively promote the development and innovation of adaptive learning technology, improve its practicability and sustainability in the field of education, and further promote the reform and development of education and teaching.

4.3. Carry out the research on the construction of adaptive learning model in each educational stage

Innovation in the field of education is an important means to promote the continuous development and progress of education and teaching, and these innovations are ultimately designed to better serve the front-line practice of education and teaching. In addition to the research and technical exploration of adaptive learning, we also need to pay attention to the application of adaptive learning technology to the actual education and teaching scenarios. In order to promote the root of adaptive learning in all stages of education, it is particularly important to carry out the construction of the corresponding adaptive learning models. It is necessary to design the corresponding models and technical paths according to the characteristics of each learning stage and subject. At the same time, also need to consider the data acquisition and analysis method, model evaluation and validation mechanism, model application and promotion in the field of education to promote students and even the teacher's interdisciplinary literacy, constantly improve the adaptive learning model is scientific, practical and reliability, promote the progress of each stages of education teaching and improve.

5. Summary

The paper, through the CiteSpace6.1.R6 software, Using the literature related to the adaptive learning topic in CNKI as a sample database for the study, after the preliminary annual publication measurement, source of literature journals, amount of author publication, research institutions, co-occurrence of keywords, emergence of keywords and other content analysis, The following conclusions are drawn: (1) in terms of the analysis of the annual publication volume, Research on adaptive learning is increasing and stable, The number of studies showed an overall positive trend since 1990, There were more significant fluctuations from 2019 to 2021, In2022, the annual journal publication volume reached the peak. (2) In terms of source analysis of literature and journals, most of the research comes from core journals, and the research quality is considerable. The research in the field of adaptive learning has been widely concerned by many top journals. (3) In terms of the analysis of the author's publications, the number of studies on adaptive learning is considerable, but the experts who systematically study adaptive learning are still in the minority, and there is no contact and cooperation between them, and the systematic core adaptive learning research team has not been established. (4) In terms of analysis of research institutions, the main force of research in the field of adaptive learning is researchers in computer related majors, which lack the active participation of normal researchers. (5) In terms of keyword co-occurrence analysis, the central keywords mainly include five aspects: adaptive, neural network, reinforcement learning, machine learning and personalization, among which the most noteworthy research focus is deep learning. (6) In terms of keyword emergence analysis, deep learning, transfer learning and artificial intelligence have not disappeared since their emergence in 2023, which plays a systematic and lasting role in the research and development of adaptive learning. (7) In terms of other content analysis, the research of adaptive learning in the field of education is lower than that in other fields. In terms of the research of adaptive learning in each education stage, the research in the higher education stage is slightly more than that in the basic education stage, and the number of each education stage is limited.

The 21st century is the era of artificial intelligence, and also the era of intelligent education. Since 2022, the popularity of ChatGPT has brought a lot of thinking and exploration to the field of education. Although artificial intelligence has brought many opportunities for the development of the field of education, it cannot effectively identify the actual needs of learning demanders, individual value pursuit and personalized level, and cannot achieve the individuation of technical education. Adaptive learning can provide learners with multi-modal and personalized learning adaptive support. With the acceleration of education modernization, adaptive learning mechanism will become emotional adaptation in the field of education, realizing the adaptive leap from "single" adaptive to "intelligent" and "advanced". Follow-up research can conform to the development trend of wisdom education, in the environment of artificial intelligence ChatGPT education stage of adaptive model and framework construction, pay attention to the improvement of adaptive learning precision and "intelligent" adaptive learning, pay attention to learners in artificial intelligence environment improve adaptive learning information the cultivation of core literacy, set up the scientific "intelligent" adaptive learning values. Similarly, researchers in the field

of education can strengthen the empirical research on adaptive learning in various stages of education, combine deep learning, project-based learning and other learning modes, promote the implementation of adaptive learning, and better serve the educational goals.

References

- [1] Xu Jianhui. *Interpretation and Enlightenment of the New Media Alliance Horizon Report: 2017 Library Edition* [J]. *Journal of University Library*, 2018, 36(01): 27-33.
- [2] *Notice of the Ministry of Education on triggering the Action Plan for Artificial Intelligence Innovation in Institutions of Higher Learning* [J]. *Bulletin of the Ministry of Education of the People's Republic of China*, 2018, (04): 127-135.
- [3] Chen Yue, Chen Chaomei, Liu Zeyuan, Hu Zhigang, and Wang Xianwen. *CiteSpace Methodological function of the knowledge graph* [J]. *Scientific Research*, 2015, 33(02): 242-253.
- [4] *The Ministry of Education issued the 10-year Development Plan for Education Informatization (2011-2020)* [J]. *China Education Informatization*, 2012, No. 274(07): 92.
- [5] Zhang Gang, Wang Zhuzhu. *Give full play to the supporting and leading role of information technology to serve the overall development of education modernization—Learn and understand the 13th Five-Year Plan of Education Informatization* [J]. *China Audio-visual Education*, 2017, No. 361(02): 140-144.
- [6] Tan Wei. *On the essence of Education and the Historical Mission of Educational Technology* [J]. *China Audio-visual Education*, 2017, No. 365(06): 54-58.
- [7] Marton F, Säljö R. *On qualitative differences in learning: I—Outcome and process* [J]. *British Journal of Educational Psychology*, 1976, (1): 4-11.
- [8] Chen Dexin, Zhan Yuanyuan, Yang Bing. *Application analysis of deep learning technology in the field of educational big data mining* [J]. *Audio-visual Education Research*, 2019, 40(02): 68-76.
- [9] Li Huan, Wu Di, Zhu Sha, etc. *Research on the construction and application of intelligent Classroom Teaching mode in the perspective of deep learning* [J]. *Modern Educational Technology*, 2023, 33(02): 61-70.
- [10] Zhang Wenlan, Su Rui. *Hot spots, trends and inspirations in the field of overseas project-based learning—Data visualization analysis based on CiteSpace* [J]. *Journal of Distance Education*, 2018, 36(05): 91-102.
- [11] Chen Enhong, Liu Qi, Wang Shijin and so on. *Key technologies and applications of adaptive learning for intelligent education* [J]. *Journal of Intelligent Systems*, 2021, 16(05): 886-898.
- [12] Li Huan, Wu Di, Zhu Sha, etc. *Research on the construction and application of intelligent Classroom Teaching mode in the perspective of deep learning* [J]. *Modern Educational Technology*, 2023, 33(02): 61-70.
- [13] Jiang Qiang, Li Yue, Sun Jie, Zhao Wei, Liu Hongxia. *Adaptive hybrid MOOC mode: a new paradigm for MOOC design* [J]. *China Audio-visual Education*, 2019(09): 82-90.
- [14] Luo Shengquan, Tan Aili, Zhong Yijun. *Ethical risks in AI education applications and their avoidance* [J]. *Education Science in China (Chinese and English)*, 2023, 6(02): 79-88.
- [15] Zhang Lele, Gu Xiaoqing. *Research on the influencing factors of the diffusion of AI innovation in education—is based on the TOE theoretical framework* [J]. *Distance Education in China*, 2023, 43(02): 54-63+82.
- [16] Zhou Qin, Wen Xinyue. *From adaptive to intelligent adaptation: a new path of personalized learning in the era of artificial intelligence* [J]. *Modern Education Management*, 2020, No. 366 (09): 89-96.
- [17] Ren Changshan. *Accelerate the promotion of 2.0 and build an upgraded version of education informatization—Interpretation of education Informatization 2.0 Action Plan* [J]. *Research on audio-visual Education*, 2018, 39(06): 29-31+89.