Analysis of the Current State of Artificial Intelligence and Higher Education Research Based on Co-word Analysis

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Abstract: In the context of the rapid development of artificial intelligence, investigating its application in higher education is of practical significance for understanding the meaning and characteristics of the integration of AI technology and university education. This study explores and analyzes the current status of artificial intelligence in higher education by collecting materials from the CNKI database and using co-word analysis and social network analysis methods. The results indicated that domestic universities are the main bodies applying artificial intelligence in higher education, with Ideological and Political Education at the core, and there is a propensity for adopting a singular model in practice. Furthermore, new elements such as 'educational informatization 2.0' are gradually being integrated into educational practices, showing innovation. Based on these findings, it is suggested to strengthen Ideological and Political Education, incorporate more interdisciplinary knowledge in AI general education, and enhance the construction of university informatization, to better apply AI technology in higher education.

Keywords: Literature Statistical Analysis, Artificial Intelligence, Higher Education, Co-word Analysis, Visual Analysis

1 INTRODUCTION

In recent years, profound changes triggered by the scientific and technological revolution have permeated all sectors of society along with its emerging technologies. Among numerous possible applications, the potential of Artificial Intelligence (AI) in higher education has garnered special attention owing to the rapid development and extensive application of AI technologies. This interest is attributable not only to the fact that higher levels of education typically involve more complex and diverse educational activities, but also to the crucial role of higher education in contemporary society and its economy. The integration of AI technology and higher education has attracted attention from both the government and relevant groups. In 2018, a national education conference planned a holistic deployment for promoting the modernization of education, building an educationally powerful nation, and delivering education that satisfies the needs of the people [1]. Subsequent educational policies have been issued by the Ministry of Education, such as the 'Education Informatization 2.0 Action Plan' and 'Notice on Carrying Out the Pilot Work of AI-promoted Teacher Team-building', aiming to continuously promote the practical process of AI technology empowering the development of higher education [2]. Therefore, analyzing the current status of AI applications in higher

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education, fully understanding the implications and characteristics associated with the combination of AI and higher education, and examining the implementation models of AI in higher education bear great practical significance.

Artificial Intelligence (AI), the cutting-edge branch of technology science devoted to modeling, extending, and enhancing human cognition, serves as a significant propeller of the new wave of technological revolution and industrial transformation. Many leading research institutions and universities abroad have been engaging in studies related to AI and education, nurturing a wealth of experts and scholars while offering theoretical and practical basis for the development of AI in education. Academics such as Adele Smolansky [3] have been examining the impact of generative AI on higher education assessment from the perspectives of educators and students.Shanshan Yang [4] et al. have probed into the opportunities, existing issues, and challenges of employing AI chatbots within higher education. Stefan A. D. Popenici [5] et al. have explored the pedagogical implications of emerging technologies on the learning strategies of students and the teaching and development approaches of institutions. Their investigative work centers around the recent technological advancements and the adoption rate of new technology within higher education, alluding to the potential role of AI in shaping the future nature of higher education in a world partaking in university structures. Nitirajsingh Sandu [6] et al. have sought the primary determinants influencing the integration of chatbot technology, aimed at enhancing the learning experience of students in India's higher education sector. Ramiz Zekaj [7] has delved into the amalgamation of AI in supporting instruction within teaching, with each scholarly piece evaluated on the basis of its content quality and relevance to the research question. The conclusions drawn suggest that AI-driven tools like ChatGPT and smart tutoring systems could significantly improve instruction and bolster adaptive learning, yielding superior educational outcomes. Moreover, studies by the likes of Krzysztof. W. Walczak [8] have navigated the advantages and potential threats of utilizing generative AI in education as well as the necessity of fostering digital literacy and ethical standards in the use of AI. Daniel Schiff [9] applied a framework of five AI ethical principles to consider how policy makers could better integrate the influence of AI ED. Meanwhile, Rinat B. Rosenberg-Kima [10] et al. have conducted research on Robot-Supported Collaborative Learning (RSCL), indicating that RSCL promises a promising new paradigm in higher education.

Compared to abroad, a large number of teachers and researchers in China have also carried out extensive educational research and practical exploration in the joint area of higher education and artificial intelligence, gradually forming a series of research results. To further investigate the current research status in the field of artificial intelligence education in Chinese universities and seek future developmental directions and trends, this study utilizes methods such as word frequency analysis and co-word analysis. It combines quantitative and qualitative research, analyzing from two dimensions: macro-distribution characteristics and micro-themed clustering content. This exploration allows us to uncover the current hot topics and developmental landscape of artificial intelligence education research in Chinese universities, providing references for the development and subsequent research of artificial intelligence education in Chinese universities.

2 DATA SOURCES AND RESEARCH METHODOLOGY

2.1 Data sources

The sample data used in this study was sourced from CNKI database. The search strategy used involved selecting 'journal articles' as the document source, subject being 'artificial intelligence' and 'university education', and setting the time span from "2016-2023". After filtering out call for papers, conference notices, papers without abstracts and keywords, as well as those irrelevant to this study, a total of 278 Chinese core journal articles were obtained. These served as the sample data for this study.

2.2 Research Methodology

Co-word analysis method was first proposed by bibliometric scholars in the 1970s [11], and was formally presented in the form of an academic monograph by the French CNRS in 1986 [12]. Its core essence revolves around the concepts of citation coupling and co-citation of bibliometrics [13]. The co-word analysis method, which calculates the relationship between keywords by tracking the frequency with which a group of keywords appear together in documents, is a type of content analysis method [14]. The social network analysis method, used in sociological research, investigates the relationships between data by analysing the correlated contacts of the network and the characteristics of its structure [15].

In this study, a combination of co-word analysis and social network analysis method was utilized. Specifically, the authors first sourced 458 pieces of information concerning industry-education integration practices from the CNKI database. The acquired information was then filtered to exclude irrelevant and repeated information, resulting in 278 journal article pieces of information. Keywords were identified from these articles. Using software tools such as NoteExpress and BibExcel, keywords were extracted from the acquired information, normalized, and the frequency of co-occurrence was calculated. Keywords with a frequency of more than 4 were selected as the subjects of study. Following this, a co-occurrence matrix of high-frequency words was established. Finally, we constructed a social network graph of high-frequency words to reveal the interrelationships between keywords. We analysed, computed, and visualized the indices of degree centrality, betweenness centrality, and closeness centrality for the nodes of high-frequency keywords.

3 MULTIMEDIA FIGURES – VIDEO AND AUDIO FILES

3.1 High-Frequency Words

With the assistance of NoteExpress and BibExcel software, this study identified 25 high-frequency words with a frequency greater than 4. These are illustrated in Table 1. As shown in Table 1, the word with the highest frequency is 'Artificial Intelligence', with a frequency of 153, followed by 'Ideological and Political Education' with a frequency of 38, and 'University' with a frequency of 36. Further, the keywords such as 'Big Data', 'Smart Education', and 'Challenge' all have a frequency greater than 7.

Table 1. Statistics of High-frequency Keywords

Keywords	Frequency	Keywords	Frequency
Artificial Intelligence	153	Path	6
Ideological and Political Education	38	Artificial Intelligence Technology	6
University	36	Higher Education	5
University Education	19	Education Informatization 2.0	5
University Ideological and Political Education	18	Talent Cultivation	5
Political Education	11	Integration	5
Artificial Intelligence Era	11	Innovation and Entrepreneurship Education	5
Smart Education	10	Robot	5
Education	8	General Education	5
Big Data	8	Accounting Education	5
Intelligent Education	8	University Political Education	4
Labor Education	7	Integrated Development	4
Challenge	6		

3.2 Construction of Co-occurrence Matrix for High-Frequency Keywords

In this study, we assigned a unique identifier, Hi, to each of the top 20 high-frequency keywords, where the value of i ranges from 1 to 25, as shown in Table 2. By employing the software Ucinet for analysis, a co-occurrence matrix of these high-frequency keywords was constructed, as presented in Formula 1.

From the co-occurrence matrix of high-frequency keywords, it can be observed that"H1-Artificial intelligence" has significant correlations with"H2-Ideological and Political Education"," H3-University" and" H4-University Education". This implies that in the educational practices of mainland China, the core of AI pertains to" H2-Ideological and Political Education", which is primarily implemented through university education, with higher education institutions largely serving as the main bodies of practice. The association between" H2-Ideological and Political Education" and" H3-University" is also considerable, suggesting that ideological and political education continually revolves around the core of universities, promoting their development through the implementation of the aforementioned educational concept.

Table 2. High-frequency Keyword Index Table

Keywords	Serial Number	Keywords	Serial Number
Artificial Intelligence	H1	Path	H14
Ideological and Political Education	H2	Artificial Intelligence Technology	H15
University	H3	Higher Education	H16
University Education	H4	Education Informatization 2.0	H17
University Ideological and Political Education	H5	Talent Cultivation	H18
Political Education	H6	Integration	H19
Artificial Intelligence Era	H7	Innovation and	H20

		Entrepreneurship Education	
Smart Education	H8	Robot	H21
Education	H9	General Education	H22
Big Data	H10	Accounting Education	H23
Intelligent Education	H11	University Political Education	H24
Labor Education	H12	Integrated Development	H25
Challenge	H13		

	H_1	H_2	H_3	H_4	H_5	H_6	H_7	H_8	H_9	H_{10}	H_{11}	H_{12}	H_{13}	H_{14}	H_{15}	H_{16}	H_{17}	H_{18}	H_{19}	H_{20}	H_{21}	H_{22}	H_{23}	H_{24}	H_{25}
H_1	0	31	27	14	11	1	7	4	7	1	7	5	0	4	6	4	2	4	3	2	2	0	2	3	1
H_2	31	0	15	0	0	1	0	0	0	0	2	0	0	0	4	1	0	0	0	0	0	0	0	0	0
H_3	27	15	0	0	0	0	4	1	5	1	1	0	1	0	3	0	1	0	0	0	1	2	0	0	1
H_4	14	0	0	0	0	1	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0
H_5	11	0	0	0	0	3	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	1
H_6	1	1	0	1	3	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
H_7	7	0	4	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H_8	4	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
H_9	7	0	5	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0
H_{10}	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
H_{11}	7	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H_{12}	5	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
H_{13}	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2
H_{14}	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	1	0
H_{15}	6	4	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H_{16}	4	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
H_{17}	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H_{18}	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
H_{19}	3	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	1	0	0	1	0	1	0	0
H_{20}	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
H_{21}	2	0	1	0	0	0	0	1	0	0	0	1	1	0	0	1	0	0	1	0	0	1	0	0	1
H_{22}	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
H_{23}	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0
H_{24}	3	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
H_{25}	1	0	1	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0

(1)

Furthermore, the close relationship between" H2-Ideological and Political Education" and" H13-Challenges" indicates that in the exploration of educational reform in mainland China, ideological and political education faces challenges earliest and places more emphasis on tackling these challenges.

3.3 Social Network Graph Analysis of High-frequency Words

To investigate the connections among various high-frequency keywords in the practice of artificial intelligence education in Chinese universities, a social network analysis method was employed using Ucinet software. The social network map of high-frequency words, which is composed of numerous nodes and connections indicating the relationships among high-frequency keywords, is presented as shown in Figure 1. As illustrated by Figure 1, "H1-Artificial Intelligence" serves as the paramount keyword. Meanwhile, "H2-Ideological and Political H9-Education" is another significant keyword, which shares close relationships with "H1-Artificial Intelligence", "H3-University", "H10-Big Data", "H13-Challenge" and so forth. "H3-University" acts as another crucial node connecting to "H1-Artificial Intelligence", "H9-Education", "H21-Robot", "H25-Integrated Development" among others. Other key nodes include "H8-Smart Education", "H10-Big Data", "H17-Education Informatization 2.0", etc.

3.4 Calculation of Centrality Indicators

The centrality indices mainly include degree centrality, betweenness centrality, and closeness centrality. To further explore the characteristics of the integration of artificial intelligence and university education, we used Ucinet software to calculate the centrality indices.

Degree centrality primarily reflects the number of connections that a node has with other nodes in the practice of integrating artificial intelligence with university education; the greater the degree centrality index, the more important the node is in the network. Let C_{RDi} represent the degree centrality of node i, which is the number of direct connections between node i and the other n-1 nodes. The degree centrality of a node is related to the scale of the network, n. The larger the scale of the network, the greater the potential value of the degree centrality. In order to eliminate the impact caused by the uncertainty of network scale, Stanley Wasserman proposed the formula for relative node centrality $C_{RDi}^{'}$:

$$C_{RDi}^{'} = \frac{\sum_{n}^{j=1} x_{ij}(i \neq j)}{n-1} \tag{2}$$

Where, $\sum_{n}^{j=1} x_{ij}(i \neq j)$ represents the number of edges directly connected between node i and other non-i nodes, that is, its absolute degree centrality(C_{RDi}).

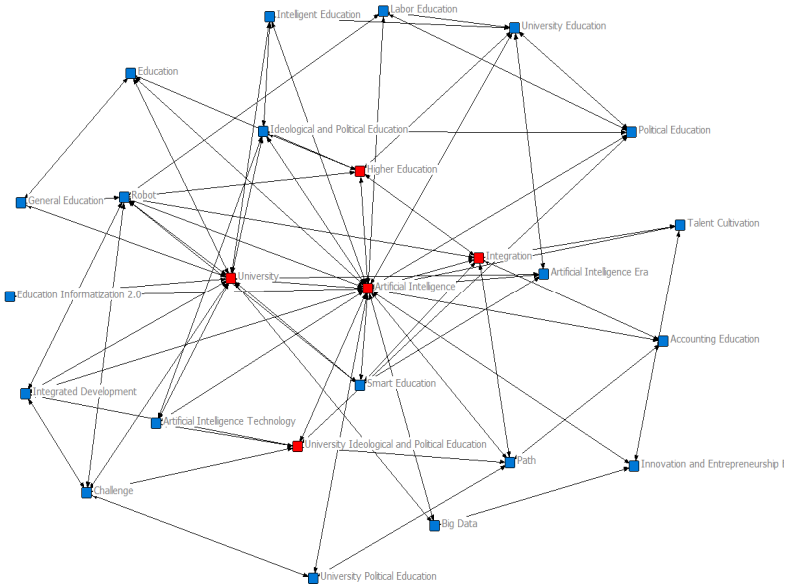

Figure 1. Social Network Map of High-Frequency Terms

The degree centrality of the integration of artificial intelligence and university education is shown in Table 3. Among them, “H1-Artificial Intelligence” has the largest degree centrality value and occupies a central position in the network, followed by “H3-University” and “H2-Ideological and Political Education” with degree centrality values of 63.000 and 54.000 respectively; the centrality is subsequently “H4-University Education” and “H5-University Ideological and Political Education”, with degree centrality values each of 19.000 and 18.000 respectively. This indicates that “H2-Ideological and Political Education”, “H3-University”, “H4-University Education”, and “H5-University Ideological and Political Education” are the crucial elements.

Betweenness centrality reflects the bridging role of a node within a network. The greater the betweenness centrality of a node, the stronger its intermediation function [16].The relative betweenness centrality of node i is:

$$C_{RBi} = \frac{2C_{ABi}}{n^2 - 3n + 2}. \tag{3}$$

Where, C_{ABi} is the absolute betweenness centrality of node i:

$$\begin{cases} C_{ABi} = \sum_{j}^{n}\sum_{k}^{n} b_{jk}(i), j \neq k \neq i, j < k \\ b_{jk}(i) = g_{jk}(i) / g_{jk} \end{cases}. \tag{4}$$

Where, $b_{jk}(i)$ represents the strength of the control ability of node i to nodes j and k, which is expressed by the number of shortest paths g_{jk} between nodes j and k and the number of shortest paths $g_{jk}(i)$ passing through node i.

Table 3. Degree Centrality of Artificial Intelligence in Association with Higher Education

Keywords	Degree	Keywords	Degree
Artificial Intelligence	148.000	Path	9.000
University	63.000	Labor Education	9.000
Ideological and Political Education	54.000	Political Education	8.000
University Education	19.000	Challenge	6.000
University Ideological and Political Education	18.000	Integrated Development	6.000
Education	14.000	Talent Cultivation	6.000
Artificial Intelligence Era	14.000	Accounting Education	5.000
Artificial Intelligence Technology	14.000	University Political Education	5.000
Intelligent Education	11.000	Innovation and Entrepreneurship Education	4.000
Robot	10.000	General Education	4.000
Higher Education	9.000	Education Informatization 2.0	3.000
Smart Education	9.000	Big Data	3.000
Integration	9.000		

The outcomes of betweenness centrality of the integration of Artificial Intelligence and University Education are presented in Table 4. Among them, “H1-Artificial Intelligence” exhibits the largest betweenness centrality with a value of 143.575, followed by “H3-University"”and “H21 -Robot”, displaying betweenness centrality values of 37.467 and 16.967 respectively. The next key node is “H19 -Integration”with a betweenness centrality of 6.875. Most nodes reveal rather low betweenness centrality values, suggesting a somewhat homogenous application model within the integration practices between Artificial Intelligence and university education.

Table 4. Betweenness Centrality of Artificial Intelligence in Association with Higher Education

Keywords	Betweenness	Keywords	Betweenness
Artificial Intelligence	143.575	University Political Education	1.383
University	37.467	Artificial Intelligence Labor Education	1.258
Robot	16.967	Smart Education	1.167
Integration	6.875	Artificial Intelligence Era	1.058
University Ideological and Political Education	5.650	Big Data	0.917
University Ideological and Higher Education	3.850	Intelligent Education	0.808
University Education	3.667	Artificial Intelligence Technology	0.708
Ideological and Political Education	3.117	Innovation and Entrepreneurship Education	0.500
Challenge	3.067	Talent Cultivation	0.500
Education	2.858	General Education	0.250
Path	2.583	Education Informatization 2.0	0.000
Political Education	2.183	Accounting Education	0.000
Integrated Development	1.592		

The closeness centrality index measures the number of connections a node has with other nodes, without considering its dominant role[17]. The relative closeness centrality of a node can be represented as:

$$C_{RPi}^{-1} = \frac{C_{APi}^{-1}}{n-1}. \tag{5}$$

Where, $C_{APi}^{-1} = C_{RDi}$, i.e., its degree of absolute closeness centrality.

The results of the closeness centrality within the context of education-industry integration practice are shown in Table 5. Among them, the closeness centrality value of artificial intelligence “H1-Artificial Intelligence”is the highest, at 92.308, followed by “H3-University"”and “H21-Robot”, with closeness centrality values of 68.571 and 61.538, respectively. The next highest values are for “H19-Integration”, “H2-Ideological and Political Education”, and “H16-Higher Education”, with closeness centrality values of 58.537, 57.143, and 57.143, respectively. Analysis of the closeness centrality results for these keywords reveals that aside from “H1-Artificial Intelligence”, “H3-University”, and “H21-Robot”, the

closeness centrality values of all other keywords fall within the 50-60 range, showing little disparity.

Table 5. Closeness Centrality of Artificial Intelligence in Association with Higher Education

Keywords	Closeness	Keywords	Closeness
Artificial Intelligence	92.308	Labor Education	54.545
University	68.571	Artificial Intelligence Technology	54.545
Robot	61.538	Artificial Intelligence Era	54.545
Integration	58.537	Education	54.545
Higher Education	57.143	Big Data	53.333
University Ideological and Political Education	55.814	Education Informatization 2.0	52.174
Smart Education	55.814	University Political Education	52.174
Integrated Development	55.814	Innovation and Entrepreneurship Education	51.064
Political Education	54.545	Challenge	51.064
Intelligent Education	54.545	Accounting Education	51.064
Labor Education	54.545	Talent Cultivation	51.064
University Education	54.545	General Education	45.283
Path	54.545		

3.5 Results Analysis

Firstly, in the practice of integrating artificial intelligence with university education in China, the main entities are currently domestic universities. According to the social network analysis results, 'University' and 'Ideological and Political Education' nodes have relatively high levels of degree centrality, betweenness centrality, and closeness centrality, demonstrating that they play a crucial bridging or intermediary role in the integration process of AI with university education.

Secondly, 'Ideological and Political Education' serves as the core in the integration practice of AI and university education. Empirical results indicate that 'Ideological and Political Education' is the second most crucial node after AI, possessing a degree centrality of 54.000, a betweenness centrality of 3.117, and a closeness centrality of 57.143. This suggests that in the practices of combining AI with university education, strengthening student ideological guidance and enhancing students' humanistic literacy are key elements.

Thirdly, AI technology involves the fusion of multiple disciplines. According to the empirical analysis results, keywords such as 'integrated development' and 'general education' demonstrate comparatively low degree centrality, betweenness centrality, and closeness centrality, such as the degree centrality of 'general education' being 4.000. This demonstrates that the role of these elements is gradually being discovered in practice, but has yet to be fully implemented.

Lastly, the integration practice of AI and university education is increasingly incorporating new elements, such as 'Education Informatization 2.0'. From the empirical analysis result, 'Education Informatization 2.0' shows a degree centrality of 3.000, a betweenness centrality of 0, and a closeness centrality of 52.174. This suggests that this keyword has not yet held a

central role in current practices and has not played a significant intermediary role. However, these emerging elements suggest that the integration of AI and university education in China is becoming increasingly innovative.

4 CONCLUSION

Based on the above research, combined with the current practice of the integration of artificial intelligence and university education in China, the following recommendations are proposed:

First, to strengthen ideological and political education. In today's rapid development of artificial intelligence, ideological and political education can help students enhance their cultural literacy, pay attention to the impact of technological progress on society, ethics, and other aspects, and have a comprehensive and in-depth understanding of the application of technology. At the same time, artificial intelligence technology may bring ethical and moral problems in some fields, and ideological and political education can provide correct guidance and thinking, making the development and application of technology more in line with social ethical norms.

Second, to enhance general education in artificial intelligence. Artificial intelligence involves the integration of multiple disciplines. When designing courses, artificial intelligence can be integrated with other disciplines, such as mathematics, physics, and linguistics. This can help students understand artificial intelligence while also mastering other disciplines' knowledge and establishing interdisciplinary thinking. Provide teachers with training related to artificial intelligence so that they can accurately impart knowledge of artificial intelligence to students and enhance the effect of general AI education. Besides traditional classroom education, online education can also be carried out using the internet and digital tools to expand the coverage of education and enable more people to access and understand artificial intelligence.

Third, to strengthen the construction of informatization in universities under the background of artificial intelligence. The construction of informatization in universities under the background of artificial intelligence can be approached from both hardware and software aspects. In terms of hardware, the use of artificial intelligence can enhance the school's network infrastructure, covering a wider area, maintaining a stable network environment, and improving the practicality and educational function of the network. Besides, deploying intelligent hardware in classrooms, such as intelligent electronic whiteboards and AI assistants, can improve teaching effects, enhance teaching interactivity, and AI-driven devices like robots and drones can provide support for experiments and research. Simultaneously, establishing large-scale data centers, combined with AI and cloud computing technology, can carry out in-depth analysis and mining of teaching, research, management, and other data to improve the school's management efficiency and teaching and research level. In terms of software, AI can be used to construct a personalized online teaching platform, realize the sharing of teaching resources, and improve teaching quality. The intelligent school management system established using AI technology can realize the intelligent management of student information, teacher information, teaching affairs information, and further improve management efficiency. Additionally, AI can also be used for academic research, providing intelligent support for research work through the analysis and mining of massive academic data.

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REFERENCES

[1]Yanxin Li, "The Path Choice of Educational Informatization in Colleges and Universities Under the Background of 'Big Data + Artificial Intelligence'," Proceedings of the 16th National Conference on Signal and Intelligent Information Processing and Application, Online (2022).

[2]Sun Yanbin and Gong Qiaoan, "Promote Educational Technology to Build a Strong Education Country - A Comparative Analysis of the 'Horizon Report' and 'Educational Informatization 2.0 Action Plan'," Science and Technology Innovation and Productivity, 34-37(07) (2019).

[3]Smolansky, A., Cram, A., Raduescu, C., Zeivots, S., and Huber, E., "Educator and Student Perspectives on the Impact of Generative AI on Assessments in Higher Education," In Proceedings of the Tenth ACM Conference on Learning (Learning '23), ACM, New York, NY, 378–382 (2023).

[4]Yang Shanshan and Evans Chris, "Opportunities and Challenges in Using AI Chatbots in Higher Education," In Proceedings of the 2019 3rd International Conference on Education and E-Learning (E-Learning '19), ACM, New York, NY, 79–83 (2019).

[5]Popenici, S. A. D. and Kerr, S., "Exploring the impact of artificial intelligence on teaching and learning in higher education," Research and Practice in Technology Enhanced Learning 12, 1-13 (December 2017).

[6]Sandu, N. and Gide, E., "Adoption of AI-Chatbots to Enhance Student Learning Experience in Higher Education in India," In 2019 18th International Conference on Information Technology Based Higher Education and Training (ITHET), IEEE, New York, NY (2019), https://doi.org/10.1109/ITHET46829.2019.8937382.

[7]Zekaj, R., "AI Language Models as Educational Allies: Enhancing Instructional Support in Higher Education," International Journal of Learning, Teaching and Educational Research 22, 8 (August 2023).

[8]Walczak, K. and Cellary, W., "Challenges for higher education in the era of widespread access to generative AI," Economics and Business Review 9, 71-100 (2023).

[9]Schiff, D., "Education for AI, not AI for Education: The Role of Education and Ethics in National AI Policy Strategies," International Journal of Artificial Intelligence in Education,527–563 (2022).

[10]Rosenberg-Kima, R. B., Koren, Y., and Gordon, G., "Robot-Supported Collaborative Learning (RSCL): Social Robots as Teaching Assistants for Higher Education Small Group Facilitation," Frontiers in Robotics and AI,6 (2019) https://doi.org/10.3389/frobt.2019.00148.

[11]Zhong, W., Li, J. and Yang, X., "A Study of Co-word Analysis Method (III)-- The Principle and Characteristics of Cluster Analysis of Co-words," Journal of Intelligence, 118-120(07) (2008).

[12]Zhong, W. and Li, J., "A Study of Co-word Analysis Method (I)-- The Process and Method of Co-word Analysis," Journal of Intelligence, 70-72(05) (2008).

[13]Feng, L. and Leng, F., "Theoretical Progress of Co-word Analysis Method," Journal of Library Science in China, 88-92(02) (2006).

[14]Wei, R., "Empirical Study on Social Network Analysis in Keyword Network Analysis," Journal of Intelligence, 46-49 (2009). 28(09)

[15]Li, W., "Academic Achievement Evaluation and Research Topic Analysis of Core Research Teams from the Perspective of Social Network Analysis," Shanxi University of Finance and Economics (2023).
[16]He, W. and Cai, Y., "Analysis of Research Hotspots in the Field of Wisdom Education in China-Based on Network Knowledge Map and Co-word analysis," Journal of education, 20-29(12) (2018).
[17]Song, Y., Xie, K., and Liang, B., "Characteristics and Causal Research of Stampede Events Based on Co-word and Network Analysis," Journal of Wuhan University of Technology (Social Sciences Edition), 29-38(1) (2019).