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# Research Evolution and Future Prospects of AI-Enabled Teaching in China (2001-2025) ——A CiteSpace-Based Knowledge Map Analysis

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ABSTRACT

*Against the backdrop of educational digital transformation, AI-enabled teaching has become an important path to advance educational reform. Based on the CiteSpace tool, this paper conducts a bibliometric analysis of 2,119 articles indexed in CNKI (Peking University Core and CSSCI journals) from 2001 to 2025, and systematically reviews the research evolution, core research groups, hot topics, and cutting-edge trends in this field. The findings show that the number of publications in this field has maintained continuous growth, experiencing three stages: initial germination (2001–2016), rapid development (2017–2020), and deepening maturity (2021–2025). Several high-impact research teams have emerged, but the overall cooperation network remains relatively loose. Research hotspots focus on technology application models, personalized teaching, teaching model innovation, teaching evaluation optimization, and the adaptation of teachers' and students' competencies. Current research is challenged by homogenized technology application, inadequate empirical research, and insufficient adaptation of teachers' and students' competencies. Future research should focus on the in-depth integration of technology with disciplines, multi-dimensional empirical testing, the construction of a teacher and student competency improvement system, and multi-scenario adaptation, so as to promote the development of AI-enabled teaching toward refinement, personalization, and normalization.*

**KEY WORDS:** artificial intelligence, CiteSpace, knowledge map, teaching reform.

## 1. Introduction

With the successive introduction of policies such as the *Action Plan for Educational Informatization 2.0*, *Key Points of Educational Informatization Work*, and *Outline of the National Education Power Construction Plan (2024–2035)*, the deep integration of AI technology with education and teaching has become the core direction of educational reform in the new era, as well as an important engine driving the high-quality development of education. Traditional teaching models are plagued by prominent pain points including insufficient personalized guidance, single and rigid teaching evaluation, uneven allocation of high-quality teacher resources, limited teaching scenarios, and difficulty in stimulating students' learning initiative, which restrict the improvement of teaching quality and the realization of educational equity. Relying


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on core advantages such as big data analysis, natural language processing, speech recognition, deep learning, and intelligent recommendation, AI technology can accurately capture learners' learning behaviors, needs, and knowledge weaknesses, construct personalized learning paths, enrich teaching scenarios, optimize the teaching evaluation system, restructure teaching processes, inject new vitality into educational reform in various fields, and help achieve the educational goal of "teaching students in accordance with their aptitude".

In recent years, scholars at home and abroad have conducted extensive research on AI-enabled teaching, covering technology application scenarios, teaching model innovation, teaching effect testing, policy support systems, and other aspects. Existing studies show that some scholars focus on the application of a single AI technology in the teaching of a specific subject (Liu Wenbo, 2025), some explore the restructuring and innovation of teaching models under the AI background (Xu Hui, Ji Ling, 2025), and others pay attention to the impact of AI on educational ecology and teacher-student relationships (Tao Xuecheng, 2025). However, on the whole, most existing studies adopt a single perspective, case studies, or local explorations, lacking a macro grasp and systematic review of the research situation, hot frontiers, and evolution paths of this field. Moreover, literature using scientific measurement tools for panoramic and visual analysis is still insufficient, making it difficult to clearly present the overall pattern and development context of the field.

In view of this, this paper introduces the CiteSpace scientific measurement tool, taking relevant literature on AI-enabled teaching published in Peking University Core and CSSCI journals in CNKI from 2001 to 2025 as research objects. By analyzing the core characteristics of each map, it intuitively presents the core information of this field, systematically dissects the research evolution characteristics and existing problems, and puts forward future research prospects. It aims to provide references for subsequent relevant research, promote the deep integration of AI with education and teaching, and support educational digital transformation and high-quality educational development.

## 2. Data Sources and Research Methods

### 2.1 Data Sources

The literature data of this paper are derived from the China National Knowledge Infrastructure (CNKI) Academic Journal Network Publishing Database. Combined with the research theme, a precise retrieval formula is constructed: *DJ = (artificial intelligence OR digital intelligence empowerment OR digital transformation) AND (teaching OR education OR talent cultivation OR teaching model OR teaching reform)*. The literature type is limited to "academic journals", the source categories are screened as "Peking University Core" and "CSSCI", and the time span is set from August 2001 to December 2025 to ensure the academic quality and representativeness of the literature and avoid interference from low-quality literature. The retrieval time is December 31, 2025, to ensure the completeness and timeliness of the retrieved data and prevent omissions due to database update delays.

After retrieval, non-academic literature such as news reports, meeting notices, call for papers, book reviews, and commentaries are manually excluded, and literature irrelevant to the research theme, repeatedly published, or mismatched in abstracts and keywords are eliminated. Finally, 2,119 valid core literatures are screened out as sample data for this knowledge map analysis.

### 2.2 Research Methods

This paper mainly adopts a combination of bibliometrics, visual analysis, and content analysis. With the help of CiteSpace 6.3.R1 Basic software, it draws author cooperation maps, institutional cooperation maps, keyword co-occurrence maps, keyword clustering maps, etc. Combined with bibliometric data and map analysis, supplemented by content analysis, it conducts an in-depth analysis of the research content, methods, and conclusions of core literatures. It systematically reviews the research status, evolution characteristics, hot topics, and cutting-edge trends in the field of AI-enabled teaching, providing solid data support and theoretical basis for research conclusions and prospects.

## 3. Research Status of AI-Enabled Teaching

### 3.1 Analysis of Literature Publication Volume

The change in publication volume can directly reflect the development speed and attention of a research field. Combined with the publication volume data of core literature in the field of AI-enabled teaching from 2001 to 2025, this paper uses Excel for statistical analysis of sample literature. According to Figure 1, the research evolution of this field can be divided into three stages with the following characteristics:

Stage 1: Initial Germination (2001–2016). In this stage, domestic AI technology was in the preliminary development stage, educational digitalization policies had not been fully promoted, and research on the integration of AI and teaching was in the early exploration period. The overall publication volume was low, with an average annual publication volume of less than 3 articles, the lowest in the entire research cycle. Research at this stage mainly focused on the concept introduction and development prospect discussion of AI technology, as well as preliminary attempts of single technology in a few subjects. The research content was relatively superficial, mostly theoretical discussion, and empirical research was scarce. No clear research hotspots or core research groups had been formed, and the practical guidance of research results was weak.

Stage 2: Rapid Development (2017–2020). With the official release of the *New Generation Artificial Intelligence Development Plan* in 2017, AI technology iterated rapidly, educational digital transformation accelerated, and AI-enabled teaching gradually attracted extensive academic attention. The publication volume showed a rapid growth trend, with an average annual publication volume exceeding 90 articles, reaching 171 articles in 2020, nearly 10 times that of 2017. Research at this stage gradually shifted from theoretical discussion to practical exploration, with richer content, focusing on application models of AI technology in various subjects and personalized teaching practice. The practical guidance of research results was enhanced, but problems such as insufficient research depth and homogenization of application models still existed.

Stage 3: Deepening Maturity (2021–2025). In this stage, educational digitalization became the core task of educational reform. The release of the *Educational Digitalization Strategic Action Plan* further promoted the deep integration of AI and teaching. The publication volume in this field maintained high and stable growth, with an average annual publication volume of more than 340 articles, reaching a record high of 728 articles in 2025. Research at this stage became more refined and systematic, focusing on core issues such as in-depth integration of technology and teaching, improvement of teaching quality, adaptation of teachers' and students' competencies, and reconstruction of educational ecology.


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Interdisciplinary cooperation gradually increased, research hotspots became clearer, a relatively complete research system was formed, and the practical guidance and innovation of research results were significantly improved.

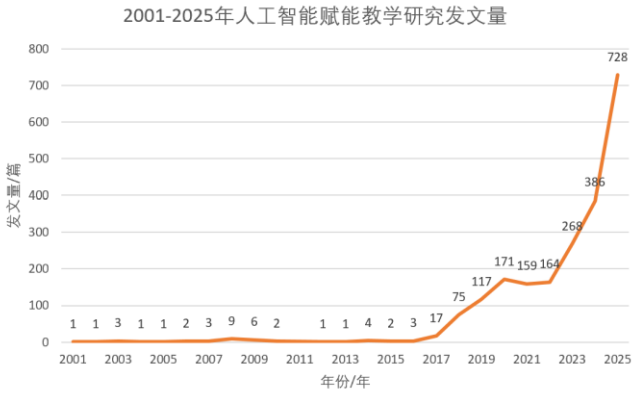


Figure 1 Distribution of Core Journal Literature on AI-Enabled Teaching Research in China (2001–2025)

### 3.2 Analysis of Scientific Research Cooperation Network

Author cooperation maps can intuitively present the distribution and cooperative relationships of core research groups in a research field. This paper sets the node type as "Author" and other parameters as default, and draws the institutional cooperation map (Figure 2) and author cooperation map (Figure 3) of the AI-enabled teaching field from 2001 to 2025 via CiteSpace. The size and number of nodes in the map reflect the co-occurrence frequency of core institutions and authors, and the number and thickness of lines reveal the closeness and strength of cooperation between different institutions and authors. The larger the node, the higher the citation frequency of the author; the thicker the line, the closer the cooperative connection between relevant authors.

The analysis finds that some high-impact core research teams have been formed in this field, mainly concentrated in key normal universities and comprehensive universities in China, such as research teams from Beijing Normal University, East China Normal University, Central China Normal University, etc. Core authors include Gu Xiaoqing, Zhao Leilei, Li Hongxiu, Wang Qiong, etc., and cooperative networks represented by Gu Xiaoqing, Zhao Leilei, Li Hongxiu, Wang Qiong, Wu Nanzhong, Zhai Xuesong, etc. have been formed. In the map, authors such as Gu Xiaoqing, Zhao Leilei, and Wang Qiong are at the center of the network with denser connections to other authors, indicating their strong academic influence and cooperation activity in this field, serving as core nodes promoting research on AI-enabled teaching. Among them, Gu Xiaoqing has the highest publication volume (14 articles), with 100% of core journal publications, focusing on practical dilemmas and breakthrough paths of AI-enabled future teaching development, leading the practical research direction of this field; Zhao Leilei has published 11 articles, mainly focusing on the connection between AI and educational technology and ethics, providing important support for theoretical research in this field. These core authors have long been committed to research on AI-enabled teaching with high publication volume and influence.

According to Price's Law: $M=0.749\sqrt{Nmax}$ (Nmax represents the maximum number of publications by an author in the field) (Derek, 1963), the threshold for high-yield authors is 2.803. Therefore, authors with 3 or more publications are defined as high-yield authors. Statistics show that high-yield authors have published 178 articles, accounting for only 8.38%, indicating that although a small number of core authors and research teams have been formed in cooperative research of this field, large-scale high-yield and high-impact scientific research cooperation teams have not yet been formed, and the overall cooperation network still has room for further expansion and deepening.

On the whole, the author cooperation network in this field is still relatively loose, showing the characteristics of "concentrated core teams, scattered overall cooperation", with a cooperation network density of only 0.0032 (the closer to 1, the closer the cooperation). Most authors conduct independent research or small-scale cooperation, with little cross-team, cross-regional, and interdisciplinary collaboration. Cooperative connections between core authors are not close enough, and a large-scale and close-knit scientific research cooperation network has not been formed. The main reasons for this phenomenon are that AI-enabled teaching research involves computer science, pedagogy, psychology, sociology, and other disciplines, researchers from different disciplines have great differences in research perspectives and methods, and the cost of interdisciplinary communication and collaboration is high, making it difficult to advance cooperative research in depth; meanwhile, some researchers lack awareness of cross-field cooperation, which also restricts the improvement of the scientific research cooperation network.

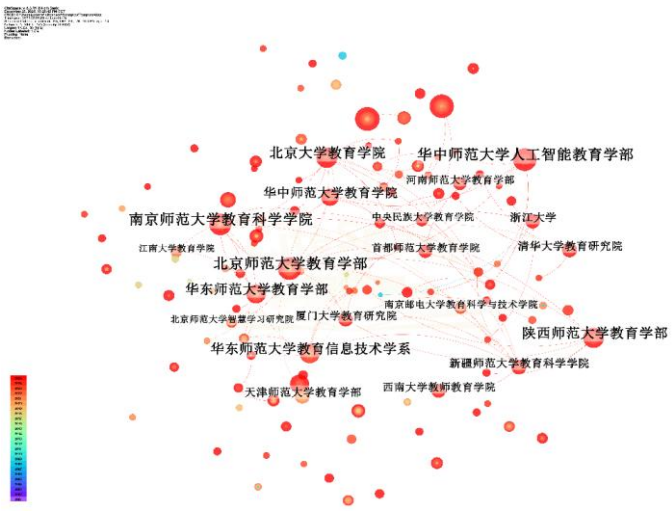


Figure 2 Institutional Collaboration Map in AI-Enabled Teaching (2001–2025)

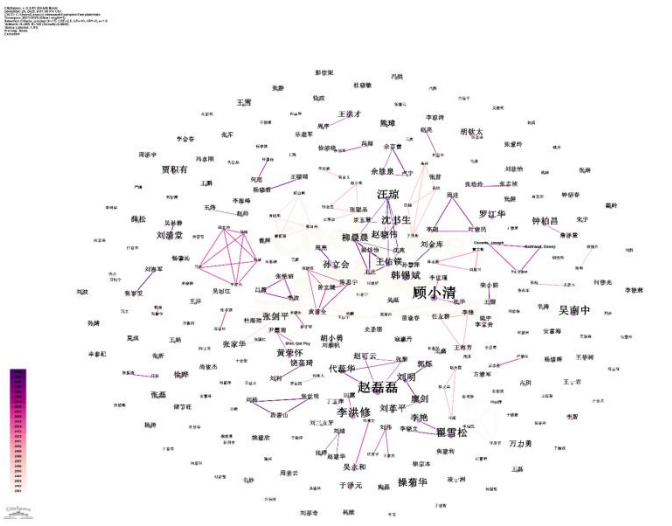


Figure 3 Author Collaboration Map in AI-Enabled Teaching (2001–2025)


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# 4. Analysis of Research Hotspots

## 4.1 Keyword Co-occurrence Analysis

Keywords are a highly condensed summary of research themes and an intuitive window for readers to understand the main content of articles except titles (Yang Xiujuan, Sun Chen, 2024). High-frequency keyword co-occurrence analysis can effectively reveal research hotspots in this field. The study uses CiteSpace to process literature data and generates a keyword co-occurrence map containing 288 keyword nodes with a network density of 0.0203. The size of keyword nodes represents their frequency in the literature; the larger the node, the higher the frequency, and vice versa. In the map, keywords such as “artificial intelligence”, “vocational education”, “higher education”, and “talent cultivation” are particularly prominent, forming a close connection network with other nodes, indicating their high-frequency co-occurrence characteristics and media role in relevant literature.

This paper sorts out the top 20 high-frequency keywords (Table 1). “Artificial intelligence” has the highest frequency of 1,079 times and the highest betweenness centrality, showing its important bridging role in this field. In addition, “vocational education” and “higher education” each appear more than 120 times, and “talent cultivation”, “teaching reform”, “human-machine collaboration”, and “educational reform” each appear more than 30 times, indicating that AI-enabled teaching has become a key research object in the field of AI and education integration.

Table 1 Top 20 High-Frequency Keywords

| No. | Keyword | Frequency | Betweenness Centrality | No. | Keyword | Frequency | Betweenness Centrality |
|---|---|---|---|---|---|---|---|
| 1 | 人工智能 | 1079 | 1.48 | 11 | 深度学习 | 26 | 0 |
| 2 | 职业教育 | 122 | 0.08 | 12 | 大数据 | 25 | 0.01 |
| 3 | 人才培养 | 122 | 0.12 | 13 | 教育应用 | 24 | 0.02 |
| 4 | 高等教育 | 70 | 0.03 | 14 | 高校 | 24 | 0.03 |
| 5 | 教学改革 | 62 | 0.03 | 15 | 技术赋能 | 24 | 0.01 |
| 6 | 人机协同 | 48 | 0.03 | 16 | 中小学 | 23 | 0.03 |
| 7 | 教育变革 | 36 | 0.01 | 17 | 智能教育 | 22 | 0 |
| 8 | 思政课 | 35 | 0.02 | 18 | 智慧教育 | 22 | 0 |
| 9 | 教育 | 27 | 0 | 19 | 教师教育 | 22 | 0.01 |
| 10 | 产教融合 | 27 | 0.01 | 20 | 新工科 | 21 | 0.01 |

By integrating and classifying high-frequency keywords, this paper finds that research hotspots mainly focus on three aspects: (1) Technology and model innovation of AI-enabled teaching. The high-frequency co-occurrence of keywords such as “deep learning”, “big data”, “human-machine collaboration”, and “intelligent technology” reflects the reshaping of teaching models, instructional design, and teaching practice by a new generation of information technology with AI as the core, and the innovation of teaching methods and means driven by technology. (2) Teaching application practice in different educational scenarios. Research focuses on educational scenarios such as “higher education”, “vocational education”, “primary and secondary schools”, and “universities”, exploring empowerment paths of AI in “classroom teaching”, “curriculum system”, “industry-education integration” and other aspects around goals such as “talent cultivation”, “core competencies”, and “fostering virtue through education”, showing diversified practices of technology implementation. (3) Ethical norms and challenges for sustainable development. The co-occurrence of keywords such as “technology ethics”, “educational ethics”, and “ethical risks” highlights the attention to issues such as data security, algorithm fairness, and educational equity in the process of AI-enabled teaching, as well as the exploration of the construction and sustainable development direction of the future intelligent educational ecology.

## 4.2 Keyword Clustering Analysis

To intuitively present the knowledge structure of research hotspots in the field of AI-enabled teaching, this paper conducts keyword clustering analysis on relevant literature. The following parameter settings are made in CiteSpace: Years Per Slice=1, Node Types=Keyword, TopN=11, Pruning=Pathfinder & Pruning sliced network & Pruning the merged network. Clustering is performed via the Log-Likelihood Rate (LLR) algorithm to obtain a visual keyword clustering map (Figure 4). The modularity value (Q value) of clustering analysis is 0.8263, and the average silhouette value (S value) is 0.9707. A Q value greater than 0.3 indicates a significant clustering structure; an S value greater than 0.7 indicates a convincing clustering result. According to the similar knowledge structure, this paper summarizes the keyword clustering results in Figure 4 into three major research themes: technology application and model innovation of AI-enabled teaching, scenario-based teaching practice and talent cultivation, and ethical norms and development guarantee.


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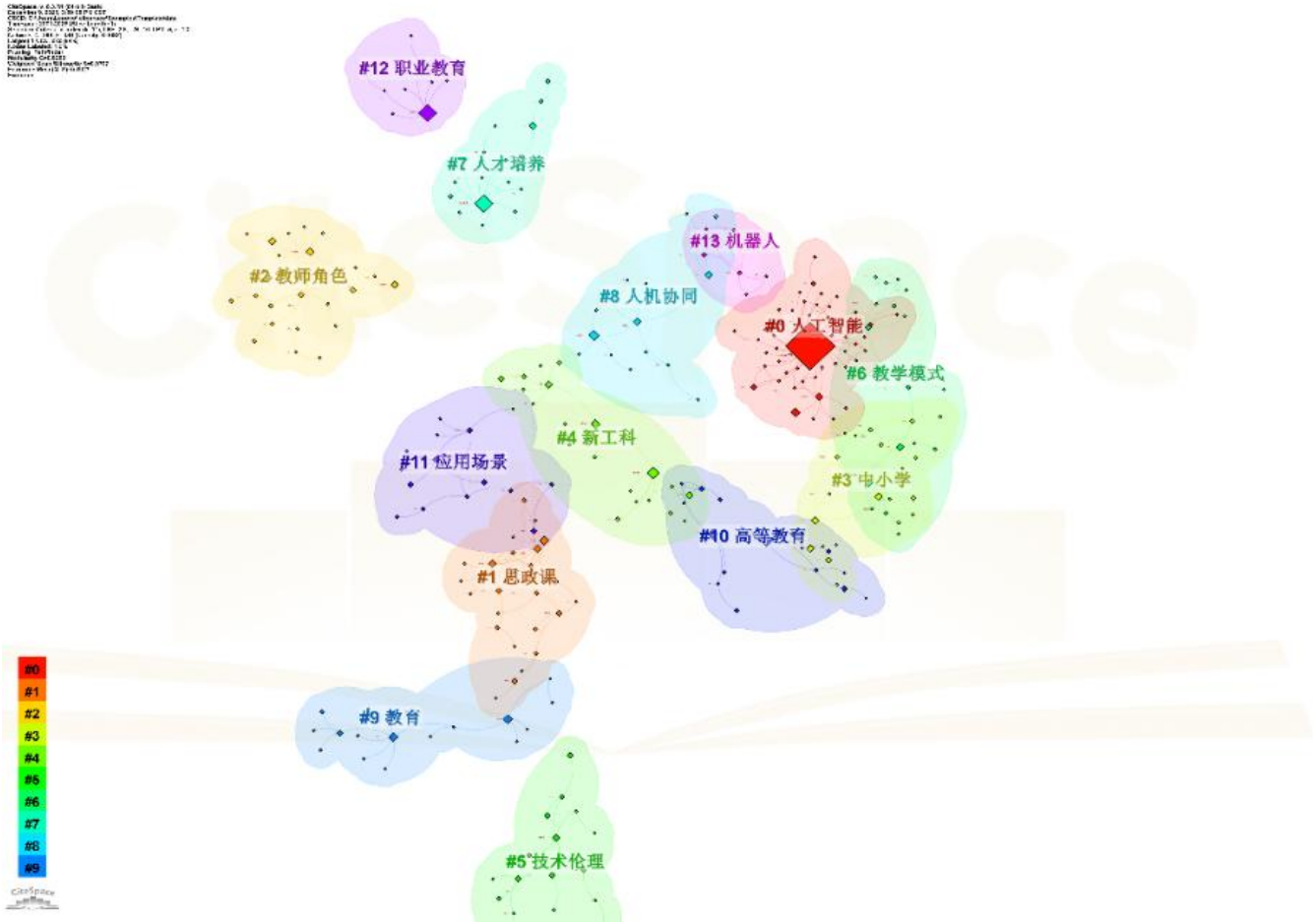


Figure 4 Keyword Clustering Map of AI-Enabled Teaching Research in Chinese Core Journals

#### 4.2.1Technical Foundation and Application Scenarios

Theme I is research on the technical foundation and application scenarios of AI-enabled teaching, the core foundation of this field, focusing on the teaching implementation of AI core technologies and multi-scenario adaptation, covering key directions such as artificial intelligence, human-machine collaboration, robots, and application scenarios, providing underlying support and implementation carriers for teaching empowerment.

Such research takes technology empowerment as the core logic, reflected in keywords such as “artificial intelligence”, “human-machine collaboration”, “robot”, and “application scenarios” in the clustering. As the core hub, AI includes underlying technologies such as deep learning, big data, and large models, supporting the entire teaching process; human-machine collaboration is the core model, breaking the traditional teacher-led structure, building a “teacher + intelligent system” collaboration system, allowing AI to undertake data processing, precise push and other tasks, and teachers to focus on irreplaceable tasks such as emotional care and thinking inspiration, realizing the integration of “teacher’s mind + AI intelligence” (Zheng Xin, 2025); as intelligent hardware, robots can improve students’ knowledge and skills, enhance learning motivation, and provide immersive practical experience (Zhan Haiying, Lu Xiaofei, 2025); application scenarios clarify specific fields such as classroom teaching, training operations, and after-school tutoring, becoming a key link connecting technology and teaching.

Current research has shifted from single technology application to multi-technology integrated scenario adaptation, and customized solutions effectively avoid the “disconnection” between technology and teaching, laying a foundation for the large-scale implementation of AI-enabled teaching.

#### 4.2.2Phased Talent Cultivation System

Theme II is research on the phased talent cultivation system of AI-enabled teaching, focusing on talent cultivation goals at different educational stages, the core application landing point of AI-enabled teaching, covering scenarios such as vocational education, higher education, and primary and secondary schools, exploring differentiated empowerment paths around talent cultivation.

Such research takes scenario adaptation as the core principle, corresponding to keywords “talent cultivation”, “vocational education”, “higher education”, “primary and secondary schools”, forming diversified application paths according to the characteristics of each school stage. Higher education integrates AI into the curriculum system around the construction of emerging engineering and emerging liberal arts, improves students’ digital literacy and innovation ability, and connects talent cultivation with industrial demand through industry-education integration; vocational education relies on AI and VR/AR to build virtual simulation training platforms, carry out interactive and immersive teaching, solve traditional training problems, and improve students’ practical operation and post-adaptation abilities (Li Zhen, 2025); primary and secondary schools focus on building intelligent education platforms, cultivating students’ core competencies, enriching teaching forms, and strengthening supervision to ensure the safe and standardized development of AI education (Zheng Xudong, Li Wangwei, 2025).

On the whole, such research highlights the core logic of “phased and differentiated empowerment”, customizes AI application schemes according to the cultivation goals and teaching characteristics of different educational stages, realizes the in-depth adaptation of technology and talent cultivation system, and promotes the dual


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improvement of education quality and talent cultivation quality at different stages.

#### 4.2.3Teaching Model Innovation and Practical Paths

Theme III is research on teaching model innovation and teacher development of AI-enabled teaching, focusing on the reshaping of traditional teaching models and teacher role transformation by AI, the core practical level of this field, covering key directions such as teaching models, emerging engineering, and teacher roles.

Such research takes model innovation as the core and teacher development as the support, corresponding to clustering keywords "education", "teaching model", "emerging engineering", "teacher role". Teaching model is the core carrier; the deep integration of AI has given birth to new models such as intelligent teaching, personalized teaching, and blended teaching, comprehensively restructuring teaching links, making learning more efficient and diversified through practices such as interdisciplinary teaching assistants, creativity stimulation, and personalized tutoring (Xiao Yi, Lai Qing, 2025). As a key practical field of higher education, emerging engineering relies on AI to restructure engineering teaching processes and practical systems, cultivate innovative talents needed by the industry. A typical case is East China University of Science and Technology's realization of personalized learning planning based on intelligent platforms and knowledge graphs (Yang Lijuan, Yin Chengrong, 2025). Teachers' roles are facing transformation, shifting from knowledge transmitters to learning guides, instructional designers, and intelligent technology applicators. Digital literacy and technology integration ability have become core measurement standards (Zhang Huiyan et al., 2025).

Current research has shifted from single model exploration to systematic research of multi-model integration and full-process empowerment, building a "technology-model-teacher" trinity system, promoting the deepening of AI-enabled teaching from technology application to model restructuring.

#### 4.2.4Ethical Norms and Development Guarantee

Theme IV is research on ethical norms and characteristic teaching practice of AI-enabled teaching, focusing on ethical risk prevention and control and technology empowerment of characteristic courses in AI teaching application, an important guarantee for the sustainable development of this field, covering key directions such as technology ethics and ideological and political courses.

Such research takes standardized development as the core goal, reflected in clustering keywords "technology ethics" and "ideological and political courses". Technology ethics focuses on the risks and regulations of AI teaching application. While enriching educational scenarios, improving quality and equity, AI also brings ethical challenges such as algorithm bias, data privacy security, and weakened critical thinking due to over-reliance on technology. Therefore, while utilizing artificial intelligence to bring convenience to the field of education, it is urgent to prudently consider and clarify the potential ethical risks it may trigger, and actively explore and test more reasonable ethical governance paradigms to ensure that human well-being always remains an important consideration in the development of intelligent technologies. (Chai & Cao, 2025). Current research focuses on building an ethical framework, designing risk prevention and control mechanisms, and clarifying technology application boundaries to ensure educational equity. As a characteristic practical scenario, ideological and political courses need to promote the deep integration of AI and ideological and political education, use technology to integrate red resources, create immersive teaching, improve the attractiveness and effectiveness of courses, and strictly abide by ethical requirements and value orientation to ensure that technology empowerment does not deviate from the essence of ideological and political education. AI not only provides support for solving dilemmas such as single content, insufficient interaction, and extensive evaluation in ideological and political courses, but also brings challenges such as algorithm bias, data security, and value alienation, testing the political attribute, value orientation, and teachers' leading position of courses (Zhang Liqun, 2025).

Such research provides ethical and value support for AI-enabled teaching, promotes the unification of technology application with educational ethics and value guidance, and prevents technological alienation from impacting the essence of education.

### 4.3 Clustering Correlation and Summary of Research Hotspots

From the perspective of correlation between clusters, the four research categories are not isolated, but mutually supportive and synergistically linked, jointly forming a complete research system of AI-enabled teaching:

The "technical foundation and application scenarios" of Theme I is the foundation, providing technical and scenario carriers for talent cultivation and teaching model innovation of Themes II and III; the "phased talent cultivation" of Theme II is the goal, clarifying the core direction of technology empowerment, and forcing teaching model innovation and ethical norms to adapt to the needs of different school stages; the "teaching model innovation and teacher development" of Theme III is the path, realizing the landing connection of technology, scenarios and talent cultivation; the "ethical norms and characteristic practice" of Theme IV is the bottom line, providing norms and value support for technology application, teaching practice, and talent cultivation.

On the whole, the research hotspots in the field of AI-enabled teaching present a complete logic of "technology as the core, scenario as the carrier, talent as the goal, model as the path, ethics as the guarantee", covering the whole chain from technology application to practical landing, from talent cultivation to standard guarantee, highlighting the systematicness and comprehensiveness of research in this field.

## 5. Research Evolution and Frontier Analysis

### 5.1 Research Evolution

To reveal the development context and evolution of AI-enabled teaching research and predict future research trends, this study uses the timeline view function of CiteSpace software to draw the evolution process of research hotspots (Figure 5).


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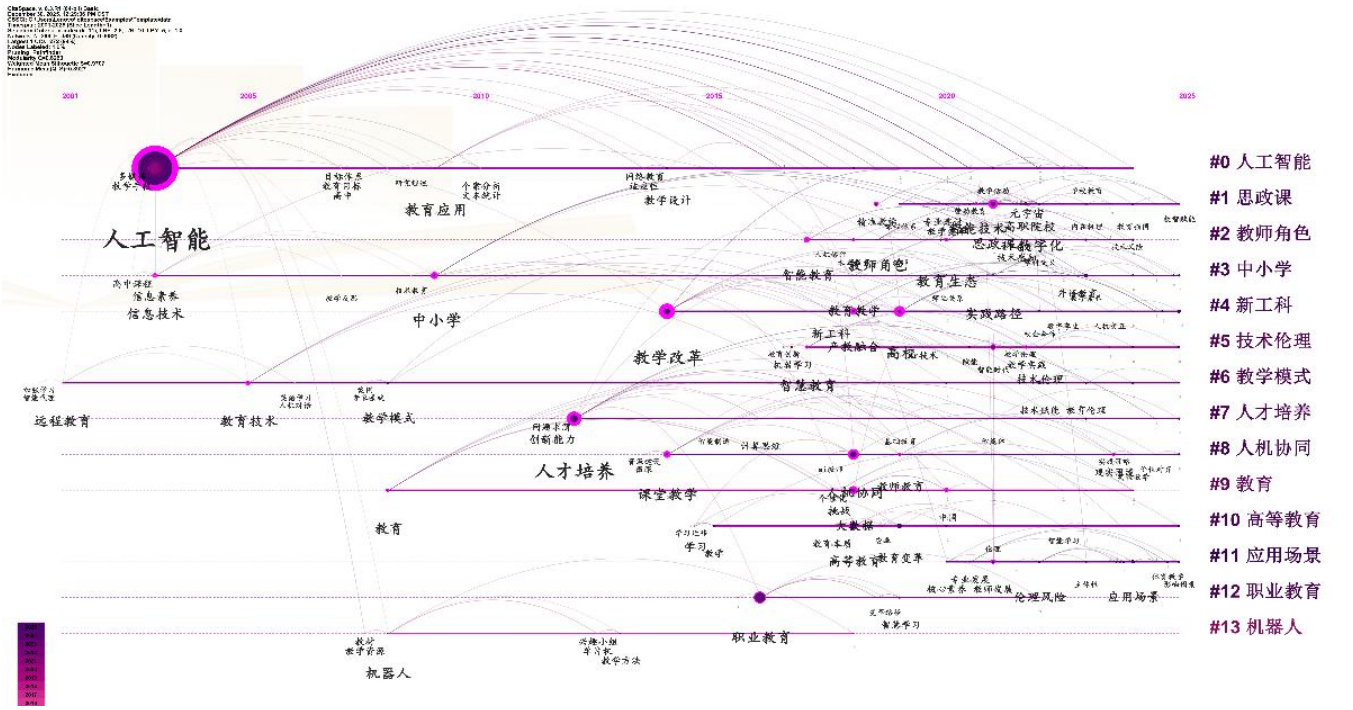
Figure 5 Timezone Map of AI-Enabled Teaching Research in Chinese Core Journals




Combined with the keyword distribution and research content characteristics of the time zone map, the evolution of research hotspots in this field has gone through three periods: initial stage (2001–2009), rapid development stage (2010–2020), and deepening maturity stage (2021–present), successively realizing the evolution from technology introduction and exploration, application model expansion to in-depth integration and system construction.

The initial stage (2001–2009) mainly takes “artificial intelligence”, “educational technology”, “information technology”, and “distance education” as clustering centers. Limited by the level of early AI technology, no systematic theoretical framework had been formed in research at this stage. It mainly discussed the feasibility and preliminary application of technologies such as multimedia, intelligent agents, reinforcement learning, and expert systems in the field of education, mostly focusing on “educational application” and “teaching models”, exploring the auxiliary role of AI in traditional teaching forms such as distance education and personalized teaching (Lan Zhangli, 2004). The research results were few and the research methods were simple, but pioneering achievements laid a theoretical and practical foundation for subsequent applications.

In the rapid development stage (2010–2020), keywords in the time zone map showed a dense growth trend, and the academic circle showed high activity in research in this field. High-frequency keywords such as “primary and secondary schools”, “teaching reform”, “talent cultivation”, and “higher education” indicated the continuous expansion of research objects and scenarios, and hotspots tended to be diversified, which was highly correlated with the promotion of the national educational informatization strategy. In July 2017, the State Council issued the *New Generation Artificial Intelligence Development Plan*, laying a policy foundation for the integration of AI into education, proposing to “develop intelligent education and accelerate the reform of talent cultivation models and teaching methods with intelligent technology” (Liu Dejian, 2019); in April 2018, the Ministry of Education issued the *Innovation Action Plan for Artificial Intelligence in Colleges and Universities*, clearly proposing to accelerate the innovative application of AI in the field of education, support the innovation of talent cultivation models, reform of teaching methods, and improvement of educational governance capacity with intelligent technology, and build an intelligent, networked, personalized, and lifelong education system (He Yi, 2020). Research hotspots at this stage are mainly reflected in three aspects: first, exploration of application paths of AI in multi-scenarios such as basic education, higher education, and vocational education. Keywords such as “primary and secondary schools”, “higher education”, and “vocational education” became research hotspots, and scholars began to discuss the application paths and adaptation models of AI technology in teaching at different school stages; second, reform and innovation of teaching models and talent cultivation. With the in-depth advancement of educational informatization, the academic circle began to pay attention to the reshaping of teaching models and optimization of talent cultivation system by AI. “Teaching reform” and “talent cultivation” became core issues. Research focused on gradually integrating AI from three parties: students, teachers, and schools, promoting the development of personalized teaching and inquiry-based learning through key paths such as learning, teaching, management, resources, and environment, and cultivating students’ innovative ability and information literacy (Liu Dejian, 2019); third, preliminary attention to potential problems such as information security and ethics, laying a foundation for the construction of subsequent ethical norms (Gao Tingting et al., 2019).

In the deepening maturity stage (2021–present), relying on the breakthrough of new-generation AI technology and educational digital transformation, the research focus has shifted from “technology application” to “system construction”, showing systematic and comprehensive characteristics. Keywords such as “human-machine collaboration”, “teacher role”, “technology ethics”, “digitalization”, and “application scenarios” show that the research focus of the academic circle at this stage is concentrated in the following aspects: construction of human-machine collaborative teaching model: research focuses on the design and practice of “teacher + AI” collaborative teaching model, exploring how intelligent systems assist teachers in completing academic situation analysis, personalized tutoring, teaching evaluation and other work, and building an efficient human-machine collaborative teaching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system (Gao Qiong et al., 2021); teacher role transformation and competency improvement: AI reshapes teaching processes, promoting teachers to shift from knowledge transmitters to learning guides and instructional designers, becoming learning-oriented, mentor-type, and collaborative roles, and focusing on the improvement paths of digital literacy and intelligent teaching ability (Liu Jianhua et al., 2023); deepening of multi-scenario and interdisciplinary application: research extends to scenarios such as "emerging engineering" and "ideological and political courses", promoting the deep integration of AI and subject teaching; AI can run through the whole process before, during and after class, helping to improve the quality and efficiency of curriculum ideology and politics, with continuously expanding application potential (Ling Yulin, 2025); ethical norms and sustainable development: "technology ethics" and "ethical risks" appear frequently, and the academic circle pays high attention to issues such as data security, algorithm fairness, and educational equity, striving to build an ethical norm and risk prevention and control system to ensure the healthy and sustainable development of AI-enabled teaching (Ti Yuanyuan, 2024). At this stage, scholars have revealed the complex impact of multiple factors such as technological iteration, educational policies, and teaching needs on the development of AI-enabled teaching. The theoretical depth and practical value of research results have been significantly improved, promoting the gradual maturity and improvement of this field.

### 5.2 Research Frontiers

This paper runs the burst detection algorithm in CiteSpace software to obtain a burst term map of the AI-enabled teaching field (Figure 6). In CiteSpace, the more burst nodes a cluster contains, the more active or emerging research trend the field becomes (Li Jie, Chen Chaomei, 2017). Keywords with a long time span indicate sustained attention and are regarded as key research directions.

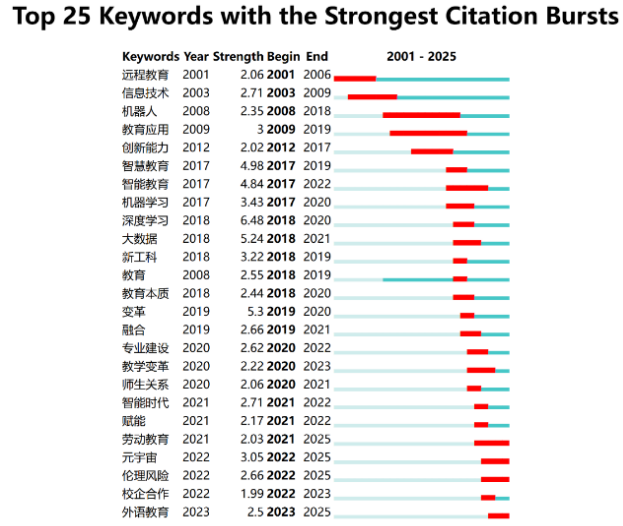


Figure 6 Keyword Burst Map of AI-Enabled Teaching Research in Chinese Core Journals

The map presents 25 burst terms, among which "deep learning" has the highest burst strength (6.48), followed by "reform" (5.3), "big data" (5.24), "smart education" (4.98), and "intelligent education" (4.84), indicating that these topics have become cutting-edge directions of widespread concern, serving as the core hotspots and important support of research in this field. From the perspective of time evolution of research hotspots, the research frontiers from 2001 to 2025 can be divided into three stages, clearly showing the progressive transformation of research focus.

From 2001 to 2009, burst terms were mainly "distance education" and "information technology" with relatively low burst strength, indicating that research at this stage was in the initial exploration period, and cutting-edge topics focused on the preliminary combination of AI-related technologies and education. Researchers began to explore the application paths of information technology and distance education models in teaching, laying a foundation for the subsequent deep integration of technology and teaching.

From 2010 to 2021, burst terms showed diversified characteristics. "Robot", "educational application", "innovation ability", "smart education", "intelligent education", "machine learning", "big data", "emerging engineering" and others successively became cutting-edge hotspots with significantly improved burst strength. At this stage, with the rapid iteration of AI technology and in-depth advancement of educational informatization, the research focus shifted from single technology application to multi-scenario practice and ability cultivation, focusing not only on the landing application of technologies such as robots, big data, and machine learning in teaching, but also on the construction of smart education and intelligent education models, and exploring the cultivation paths of students' innovative ability under technology empowerment, reflecting the practical and diversified development trend of research.

From 2022 to 2025, burst terms further focused on "intelligent era", "empowerment", "metaverse", "ethical risk", "labor education", "school-enterprise cooperation", "foreign language education", etc. Among them, "ethical risk", "metaverse", and "labor education" lasted until 2025, becoming cutting-edge topics of widespread current concern. The transformation of research focus reflects the deepening direction of AI-enabled teaching research: on the one hand, with the advent of the intelligent era, research focuses on teaching reform, major construction, and school-enterprise cooperation, exploring the restructuring of teaching models and talent cultivation systems under technology empowerment; on the other hand, the rise of emerging technologies such as metaverse promotes the innovative application of teaching scenarios, while issues such as ethical risks and educational equity have become research priorities, reflecting researchers' attention to the standardization and sustainability of technology application, as well as the transformation of AI-enabled teaching research from "technology application" to "system construction and ethical norms", in line with the era demand of high-quality educational development.

## 6. Conclusions and Prospects

Based on the visual analysis of domestic core journal literature on AI-enabled teaching from 2001 to 2025, it can be seen that this field shows a sustained growth trend as a whole. The research has successively experienced three stages: initial germination, rapid development, and deepening maturity. The research focus has gradually shifted from the introduction and preliminary exploration of technical concepts to multi-scenario practical application, and then to the systematic construction of human-machine collaboration, educational ecology, and ethical norms. A knowledge structure with technical foundation and application scenarios, phased talent cultivation system, teaching model innovation and practical paths, and ethical norms and development guarantee as the core has been formed. At the same time, high-yield authors and core research teams represented by Gu Xiaoqing, Zhao Leilei, Li Hongxiu, Wang Qiong, etc. have emerged in this field, but the overall cooperation density is low, cross-institutional and interdisciplinary cooperation is insufficient, and a large-scale and cohesive scientific research


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cooperation community has not yet been formed. Current research presents evolutionary characteristics of shifting from technology-driven to policy and demand-driven, and from a single perspective to interdisciplinary comprehensive perspective. Burst terms show that cutting-edge hotspots focus on ethical risks, human-machine collaboration, teacher roles, metaverse, labor education, etc., but there are still prominent problems such as homogenization of technology application, insufficient empirical research, insufficient support for teachers' and students' competencies, unbalanced regional development, and imperfect ethical governance system.

Facing the needs of educational digital transformation and the construction of a strong education country, future research on AI-enabled teaching should take the essence of education as the basis, promote the shift from shallow tool application to in-depth integration under subject adaptation, from qualitative interpretation to long-term empirical research with quantitative, longitudinal and mixed methods, from technology-centered to the coordination of teacher-student subjects and educational ecology, from a single discipline to interdisciplinary integration and balanced regional development. At the same time, it is necessary to accelerate the construction of a governance framework integrating ethical review, data security and algorithm fairness, and finally realize the high-quality, sustainable and standardized deep integration of AI and teaching, supporting high-quality educational development and the realization of educational equity.

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