2025 Volume 3, Issue 3
Educational Innovation Research
ISSN: 3029-1844(Print)
ISSN: 3029-1852(Online)

The Practical Application of Big Data and Artificial Intelligence Technology in Educational Management

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Abstract:

The practical application of big data and artificial intelligence (AI) technologies in educational management has become a crucial means to promote education modernization. These technologies are profoundly transforming the models and methods of educational management by optimizing management processes, enhancing educational quality, and achieving personalized education goals. This paper analyzes the practical applications of big data and AI technologies in educational management, aiming to inspire further discussions and research.

Keywords:

Big data
Artificial intelligence technology
Educational management
Practical application

Online publication: April 26, 2025

1. Introduction

Artificial intelligence (AI) is transforming the education ecosystem with unprecedented speed and depth. The Guidelines for the Integrated Application of National Smart Education Platform for Primary and Secondary Schools and Artificial Intelligence proposes a framework for five major application areas, revealing how AI can comprehensively empower classroom teaching [1]. With the rapid development and popularization of generative AI, the "access threshold" in the education sector has been continuously lowered, and the human-AI collaborative teaching model is becoming the new normal. This paper will deeply explore the innovative applications of AI in educational management to help educators better grasp the new opportunities of AI-empowered education [2].

2. Applications of big data in educational management

2.1. Data-driven precise governance

Big data technology provides a scientific decision-making basis for educational managers by collecting and analyzing various data in the education operation process, such as students' learning behaviors, teachers' teaching behaviors, and the usage of curriculum resources. For example, in teaching quality evaluation, by analyzing students' learning data and teachers' teaching behavior data, a comprehensive evaluation index system can be constructed to timely identify teaching problems and put forward improvement suggestions. In addition, big data can also help schools optimize resource allocation, such as reasonably distributing teaching materials and teaching staff according to data analysis results [3].

2.2. Intelligent management and services

The application of big data technology has shifted educational management from traditional experience-driven to data-driven. For instance, through a learning analysis system, schools can gain real-time insights into students' learning dynamics, recommend suitable learning resources and paths, thereby improving learning outcomes. Meanwhile, big data helps schools achieve intelligent management, such as automatic class scheduling and grade analysis, which significantly enhances work efficiency [4].

2.3. Educational equity and personalized development

Big data technology contributes to the rational allocation of educational resources and the promotion of educational equity. For example, by analyzing students' learning needs and development trends, managers can provide more targeted educational resources. Moreover, big data supports the realization of personalized education by analyzing students' learning habits and ability characteristics to tailor learning plans for each student.

2.4. Case studies

Colleges and universities serve as important application platforms for technology. In 2018, the Ministry of Education issued the Artificial Intelligence Innovation Action Plan for Higher Education Institutions [5], encouraging the exploration of an "AI+X" talent cultivation model. In colleges and universities, big data technology is widely applied in teaching management and decision-making. For example, by analyzing students' learning behavior data and teachers' teaching behavior data, universities can optimize the allocation of teaching resources and teaching quality evaluation. Additionally, some universities have developed intelligent recommendation systems using big data technology to provide personalized learning suggestions for students. For example, Tsinghua University is one of the first institutions in China to engage in artificial intelligence teaching and research [6–8]. Relying on the independently developed GLM4 large model with hundreds of billions of parameters and independent intellectual property rights as the platform and technical foundation, Tsinghua University has launched pilot work for eight courses. By leveraging existing teaching data, public research papers, MOOC resources, and other materials, it fine-tunes GLM4 to form vertical domain models for different courses, and develops exclusive AI teaching assistants capable of functions such as example generation, automatic question creation, question answering and confusion clarification, computational reasoning, and evaluation guidance.

3. Applications of artificial intelligence in educational management

3.1. Intelligent teaching and personalized learning

AI technology can provide students with personalized learning experiences by analyzing their learning data [9]. For example, California State University uses AI technology to predict students' learning performance and provide timely academic guidance and intervention measures. Furthermore, AI can help teachers adjust teaching content and methods through intelligent learning software and online learning platforms to improve teaching efficiency.

3.2. Teacher support and teaching optimization

AI technology can provide intelligent teaching support for teachers. For instance, AI teaching assistants can assist teachers in grading homework, answering students' questions, and adjusting teaching plans according to students' learning situations. Moreover, AI can help teachers better meet students' needs by generating personalized teaching materials and curriculum plans [10].

3.3. Automation and intelligence of educational management

The application of AI technology makes educational management more efficient and intelligent. For example, in campus management, AI technology can be used for attendance management, homework supervision, and school affairs supervision. In addition, AI can provide managers with scientific teaching evaluation reports through virtual assistants and intelligent evaluation systems.

3.4. Case studies

In practice, AI technology has been widely applied in various educational scenarios. For example, the "Smart Learning Companion" project uses AI technology to

perceive and analyze students' learning behaviors, thus achieving precise teaching. Besides, some schools have developed virtual oral coaches and intelligent examination systems to provide students with immersive learning experiences. Beihang University's full-process interactive online teaching platform, based on generative large models, machine and deep learning, and other artificial intelligence technologies, connects all online and offline teaching links of teachers, forming a closed loop of students' pre-class, in-class, and after-class learning. Taking the 323 smart classrooms covered by the university as the foundation, it carries out digital processing of recorded course resources. With the full-process online teaching platform as the conditional support, it has developed an all-weather accompanying intelligent knowledge answering assistant to solve various problems in students' learning process [11].

4. Integration of big data and artificial intelligence

4.1. Synergistic effects

The combination of big data and AI brings greater potential to educational management. For example, by analyzing students' learning data through big data and conducting in-depth mining with AI technology, it is possible to more accurately predict students' learning needs and development trends [12]. Moreover, this integration can help schools achieve dynamic optimization of educational resource allocation.

4.2. Challenges and problems

Although the application of big data and AI in educational management has broad prospects, it also faces some challenges. For example, issues such as data privacy protection, high technical costs, and insufficient technical capabilities of teachers need to be taken seriously. To address these, schools should strengthen data security protection measures and enhance teachers' technical application capabilities through training.

4.2.1. Challenges in data security and privacy protection

Educational data includes sensitive information such as students' personal details, learning behaviors, and psychological assessments. Once leaked, it can cause serious harm to students' rights and interests. However, current data encryption technologies and security protection systems still have vulnerabilities. Some educational institutions, due to insufficient technical capabilities or management negligence, struggle to resist hacker attacks and data theft. Additionally, in scenarios such as cross-border data flows and third-party platform access, vague definitions of rights and responsibilities lead to increased risks of privacy breaches [13].

4.2.2. Adaptability and limitations of technological applications

Most existing big data analysis models and artificial intelligence algorithms are developed for general scenarios, failing to meet the complex needs of educational management. For example, in personalized learning path planning, algorithms may ignore unstructured data such as students' emotional factors and family environments, resulting in recommendations that deviate from actual needs. Meanwhile, issues such as sample bias and non-standard labeling in educational data can easily trigger algorithmic discrimination, exacerbating educational inequity.

4.2.3. Insufficient technical competency of educators

Despite the continuous update of technical tools, some teachers and managers still have a preliminary understanding of big data analysis and artificial intelligence applications, lacking the ability to interpret data, apply models, and make intelligent decisions. Problems such as insufficient training resources and limited practical opportunities further restrict the deep integration of technology and educational management, causing intelligent tools to become formalistic "ornaments."

4.2.4. Lagging institutional and regulatory systems

Existing educational management systems are mostly designed based on traditional management models and lack a normative framework for the application of intelligent technologies [14]. There are no unified standards for key links such as data usage rights, algorithmic ethics review, and liability tracing, leading to risks of disorderly technology application. The mismatch between regulatory

measures and the pace of technological development makes it difficult to effectively prevent the abuse of technology.

4.2.5. Unbalanced technological investment and regional development

The deployment of big data and artificial intelligence technologies requires high capital and professional team support. However, educational institutions in underdeveloped regions struggle to afford costs such as server construction and algorithm research and development due to financial constraints. The significant gap in technological application levels between regions has exacerbated the unequal distribution of educational resources and hindered the achievement of educational equity goals.

4.3. Effective measures

4.3.1. Intelligence and transparency of educational management

Big data and artificial intelligence technologies have shifted educational management from experience-oriented to evidence-oriented through data-driven approaches. For example, by analyzing students' learning behaviors, teachers' teaching practices, and school management data, a comprehensive evaluation system can be established to promptly identify issues in the educational process and propose improvement suggestions. Additionally, AI technologies enable real-time monitoring of educational processes and intelligent early warning systems, thereby enhancing the transparency and predictability of educational management.

4.3.2. Optimal allocation of educational resources

Big data technologies can analyze the utilization of educational resources to optimize their allocation and improve efficiency. For instance, by examining data on curriculum scheduling and teacher deployment, schools can allocate resources more rationally. Meanwhile, AI algorithms facilitate the online circulation of high-quality educational resources, promoting educational equity. In scientific research, AI tools help teachers quickly understand the current status and hot issues of research topics, construct research frameworks, and improve research capabilities and the success rate of project applications. The scenario of "project framework construction" demonstrates how teachers can efficiently use academic resources through AI tools to initially build project application frameworks. The "academic originality verification" scenario assists teachers in intelligent academic integrity management and improves the quality of educational research. Teachers can use AI tools to detect language errors in papers and check the originality of their work, thereby avoiding academic misconduct. This not only enhances the quality of teachers' research papers but also ensures the standardization and originality of academic research [15].

4.3.3. Personalized education and teaching improvement

Artificial intelligence technologies can provide personalized learning plans and tutoring suggestions based on students' learning conditions, helping teachers better understand students' learning status and adjust teaching strategies. Furthermore, by analyzing students' learning data, AI can predict learning trends and needs, thereby supporting educational decision-making. AI technology provides intelligent support for the design and organization of teaching and research activities. Novice teachers can leverage digital resources on platforms and use AI to design high-quality teaching and research activity plans. By analyzing the highlights and transferable components of excellent teaching and research cases, AI can generate structured and clearly outlined teaching and research plans, enhancing the pertinence and effectiveness of such activities. In the scenario of "high-quality course production," AI assists teachers in deconstructing high-quality teaching cases. By comparing their own lesson plans with those of excellent courses, teachers can receive specific improvement suggestions. This precise comparative analysis helps teachers identify clear directions for improvement, accelerate their professional growth, and achieve the transition from novices to experts.

4.3.4. Dynamic monitoring and evaluation of educational quality

The big data-based intelligent educational decision-making system enables dynamic monitoring of educational quality and presents data results through

visualization tools, providing a scientific basis for managers. For example, by integrating classroom teaching data, homework data, and assessment data, a comprehensive evaluation of teaching quality can be conducted, with targeted improvement suggestions offered. AI technology provides data support and intelligent analysis for educational decision-making. The scenario of "AI assisting school official document writing" demonstrates how to use AI tools to efficiently complete official document writing tasks and improve school administrative efficiency. The scenario of "human-computer collaboration in building emergency response plans" shows how AI technology can be used to identify safety hazards, quickly respond to emergencies, and accurately push safety education content, thereby constructing a full-process safety management system. In the scenario of "AI helping to resolve regulatory challenges," AI technology offers solutions for the supervision of online education platforms. By reducing educational anxiety through public supply as the main approach, combining high-quality resources from the National Smart Education Platform for Primary and Secondary Schools, and establishing stratified and classified access and exit mechanisms, a model of "public safety net + market supplementation" is formed. This not only safeguards the public welfare nature of education but also promotes the sustainable development of the industry. These application scenarios fully demonstrate the value of AI in educational governance—improving the efficiency and accuracy of educational management through data-driven, precise decision-making, and providing strong support for the high-quality development of education.

4.3.5. Modernization of educational governance

The application of big data and artificial intelligence technologies has also promoted the modernization of educational governance. For example, blockchain technology ensures the tamper-proof and transparent management of educational data, enhancing the credibility of educational management. Additionally, cloud computing technologies enable the sharing of educational resources and the optimization of service models. AI is reshaping the way schools communicate with families. The "home-school-community collaborative education practice" scenario, implemented through the AI platform "Beijing Education New Map," establishes a closed-loop educational model of "online learning–offline practice–achievement sharing." The platform provides functions such as base queries, AI-powered dialogue, and home-school collaborative education for teachers, parents, and students, breaking down communication barriers among homes, schools, and communities while promoting information sharing and resource integration. The Guidelines for the Integrated Application of the National Smart Education Platform for Primary and Secondary Schools and Artificial Intelligence identifies "home-school-community collaborative education" as a key application field. By optimizing collaboration processes among homes, schools, and communities, AI technology promotes information sharing, resource complementarity, and targeted policy implementation, effectively integrating the resources of these three parties and fostering the establishment and improvement of a collaborative education mechanism.

5. Conclusion

From the intelligentization of the entire curriculum teaching chain to the personalized guidance of teacher-student development, from the intelligent empowerment of teaching research and scientific research to the precise decision-making of educational governance, from the collaborative innovation of home-school-community co-education, AI technology is building a more open, intelligent, and efficient educational ecosystem. The practical application of big data and AI technology in educational management has demonstrated strong potential. These technologies can not only improve the scientific and refined level of educational management but also promote educational equity and personalized development. However, during the promotion process, attention should also be paid to issues such as data privacy protection and technology popularization. In the future, with the continuous advancement of technology and the expansion of application scenarios, big data and AI will play a more important role in educational management. The new paradigm of human-computer collaborative education will be further deepened, and scenarios of AI-empowered classrooms will become more diverse, leading to more profound transformations

in teaching and learning methods. Only by actively embracing this transformation can educators maintain their professional advantages in the AI era and lead the innovative development of education.

Disclosure statement

The author declares no conflict of interest.

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