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Innovation and Practice of Classroom Teaching Empowered by Digital Intelligence Technology

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Abstract: With the rapid development of information technology, digital intelligence technology has gradually penetrated into the field of education, bringing profound changes to classroom teaching. Based on the background and trend of the current development of digital intelligence technology, this paper analyzes the innovation and practice of digital intelligence technology in classroom teaching. First, this paper expounds the application scenarios of digital intelligence technology in the field of education, and through the introduction of advanced technologies such as big data analysis, artificial intelligence, and cloud computing, the acquisition, integration, and utilization of educational resources have become more efficient and convenient. These technologies not only enrich the teaching methods, but also improve the pertinence and effectiveness of teaching. Secondly, this paper discusses the problems faced by digital intelligence technology in the application of classroom teaching, summarizes the practical path of classroom teaching reform driven by digital intelligence technology, and finally expounds the future prospect of digital intelligence technology empowering classroom teaching. The application of digital intelligence technology not only improves the quality and efficiency of teaching, but also promotes the equity and personalized development of education. Digital intelligence technology provides new impetus and possibilities for classroom teaching reform. In the future, with the continuous progress of technology and the continuous updating of educational concepts, the application of digital intelligence technology in the field of education will be more extensive and deeper.

Keywords: Digital intelligence; Technology; Classroom teaching reform; Personalized instruction; Education modernization

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1. Research Background

The digital era is witnessing continuous transformation, with social organizational forms undergoing disruptive changes. The integration of modern information technology revolution, represented by new-generation digital technologies such as big data, artificial intelligence, the Internet of Things, and virtual

reality, with the Fourth Industrial Revolution jointly drives the leap of digitalization and the development of digital intelligence.[1] Digital intelligence technology is the organic fusion of digitalization and intelligence. It is a process that integrates and applies intelligent technologies such as machine learning and artificial intelligence on the basis of digitalization. Empowering classroom teaching with digital intelligence technology refers to a new teaching model that utilizes digital and intelligent technologies to enhance and optimize the classroom teaching process. This teaching model, by integrating modern information technologies such as artificial intelligence, big data, the Internet of Things, and cloud computing, provides teachers and students with richer, more convenient, and personalized teaching resources and tools, thereby improving teaching quality and learning outcomes.[2] The digital intelligence transformation of education is a reform trend for future education. An AI-driven education system can provide students with large-scale, personalized teaching services. China's "China Education Modernization 2035" states that "accelerating educational transformation in the information age" is one of the ten strategic tasks of China's educational reform. Modern information technology will boost China's educational development and promote educational reform. 20th National Congress of the Communist Party of China emphasized the need to "advance educational digitalization." According to the changing demands of social talent and technological development, promoting the realization of educational digital transformation is the primary task of China's educational reform. The "Key Work Points of the Ministry of Education in 2023" states: "2023 marks the inaugural year for fully implementing the spirit of the 20th National Congress of the Communist Party of China, a pivotal year bridging the implementation of the 14th Five-Year Plan, and a critical year for education to maintain its strategic focus and priorities." The current priority is to "deepen the strategic action of educational digitalization," fostering innovative integration of digital intelligence technologies with educational reforms, empowering educational advancement, and driving high-quality development. From 2019 to 2022, China and UNESCO jointly hosted four editions of the "International Conference on Artificial Intelligence and Education," highlighting AI's crucial role in educational reform. The future of education is defined by "AI and big data technologies leading intelligent upgrades" and "empowering pedagogical innovation," signaling that digital intelligence has reached a new stage of educational reform and development, with future progress moving toward greater specialization and deeper integration. As the fusion of digitalization and intelligence, digital intelligence has not only reshaped economic structures and industrial patterns but also profoundly influenced educational development.[4] Against this backdrop, classroom teaching—the core component of educational activities—is confronting unprecedented challenges and opportunities.

Traditional classroom teaching models often focus on knowledge infusion and exam-oriented skill development, struggling to meet students' personalized and diversified learning needs in the new era. Meanwhile, with the widespread adoption of information technology, students now have access to increasingly diverse information channels, making conventional teaching methods inadequate in stimulating interest and improving learning efficiency. The rise of digital intelligence technologies offers new possibilities for classroom teaching reform. By leveraging advanced technologies such as big data, cloud computing, and artificial intelligence, we can achieve optimized allocation of teaching resources, intelligent management of teaching processes, and precise evaluation of learning outcomes. These technological applications not only enhance teaching quality and efficiency but also provide students with more personalized and flexible learning experiences.

This study aims to analyze the application status of digital intelligence technology in classroom teaching, put forward the practical path of digital intelligence empowerment in classroom teaching, and provide new

ideas and directions for classroom teaching reform.

2. Application scenarios of digital intelligence technology enabling classroom teaching

2.1. Construction and application of intelligent teaching platform

The "Ten-Year Development Plan for Educational Informatization (2011-2020)" emphasizes "promoting deep integration of information technology with education, accelerating digital transformation of curricula, innovating information-based teaching and learning methods, and enhancing personalized interactive instruction."[5] An intelligent teaching platform refers to an educational tool that utilizes information technology and artificial intelligence to provide online teaching, learning management, and resource sharing. The core technologies in building such platforms include artificial intelligence, which employs machine learning algorithms and deep learning techniques to achieve intelligent content recommendation, behavioral analysis, and decision support. It collects massive teaching data, leveraging data mining and visualization technologies to gain deep insights into learning patterns and teaching effectiveness. Natural language understanding and generation technologies enable intelligent Q&A, homework grading, and content creation. Combined with 3D modeling and interactive technologies, it creates immersive virtual experiments and learning environments. As a pilot zone for "AI-driven teacher team development" and "Shanghai's Educational Digital Transformation Zone" under the Ministry of Education, Baoshan District in Shanghai has vigorously promoted digital transformation to drive high-quality educational development.[6] The "Future Bao" educational digital foundation serves as an "operating system" for educational governance and classroom teaching. Built on next-generation information technologies including the internet, artificial intelligence, and big data, it establishes a multi-dimensional ecosystem application system that aggregates multi-source data and focuses on application scenarios such as teaching, learning, management, assessment, research, and resource utilization. Functioning as an educational digital foundation, "Future Bao" provides organizational management and data transmission capabilities, significantly reducing teachers' workload while enhancing efficiency in daily operations. Covering all educational institutions across the region, including schools, teachers, students, and parents, the platform facilitates extensive interaction and connectivity. On the "Future Treasure" platform, teachers conduct online classroom instruction and live-streamed lessons, while students participate in course learning, complete assignments, and take tests. The platform also provides abundant teaching resources and learning tools to support personalized student learning and precise teacher instruction. It enables teacher teams to implement synchronized "1+N" scenarios for lesson preparation, teaching, research, training, and after-school extended services. By breaking geographical and temporal constraints, the platform creates a new paradigm of integrated online-offline teaching and research collaboration, effectively addressing educational disparities.

2.2. Design personalized learning paths

Digital intelligence technology facilitates the transition from traditional rote-learning, training-focused, and captive-style education to personalized learning paradigms. Within the digital intelligence framework, transforming mathematical learning approaches forms the core of mathematics education reform, with personalized learning being the key to achieving pedagogical transformation.[7] Through practical exploration, digital intelligence technology has injected new vitality and possibilities into classroom teaching reform. Its essence lies in leveraging big data analytics to deeply examine students' learning conditions, thereby designing

customized learning resources and pathways to achieve precise teaching objectives. Specifically, this practice involves collecting and analyzing multidimensional data generated during students' learning processes—such as academic progress, performance metrics, interaction frequency, and interest preferences—to create individualized learning profiles. [8] Based on these detailed data insights, educators can tailor teaching content, learning activities, and assessment methods, developing personalized learning plans that align with each student's ability level, learning pace, and interests. This data-driven, student-centered teaching model not only significantly enhances instructional precision and effectiveness but also promotes self-directed learning.

2.3. Intelligent tutoring and teaching assessment

Developing high-quality and efficient new classroom teaching models presents significant challenges. The interactivity involves multiple stakeholders, the knowledge exploration and construction process is more complex, and the patterns of cognitive progression and evolution remain implicit. Traditional methods relying solely on experts' subjective evaluations and guidance cannot scientifically and accurately assess classroom teaching quality, nor can they support large-scale teaching improvement and research initiatives. With the release of GPT series technologies, generative artificial intelligence has demonstrated remarkable capabilities in natural language understanding and content generation. The intelligent emergence, strong cognitive abilities, and high versatility of these technologies bring new opportunities for educational digital transformation. This will reshape teaching methodologies and research paradigms, driving profound changes in classroom instruction and providing technical support for optimizing classroom teaching evaluation.[9] Digital intelligence technologies can assist teachers in instructional guidance and student learning assessments. For example, intelligent tutoring systems utilize AI to provide personalized support, helping students overcome learning difficulties. These systems also track learning progress, offering teachers feedback to adjust teaching strategies. Through data analysis, educators can understand students' learning pace, mastery levels, and challenges, enabling targeted instruction. Additionally, digital intelligence technologies provide learning reports that help teachers better understand student performance.

2.4. Immersive learning experience

Digital intelligence technologies can provide students with immersive learning experiences that make education more engaging and dynamic. Take virtual reality (VR) technology as an example: Through VR, students can virtually experience learning content such as historical event reconstructions and scientific experiment simulations, thereby deepening their understanding and retention of knowledge. Augmented reality (AR) technology, on the other hand, precisely overlays digital information and 3D virtual models onto real-world environments, offering students more intuitive learning experiences. For instance, in geography education, teachers can use AR to demonstrate changes in terrain and landforms, helping students better grasp geographical concepts.

3. The problems faced by classroom teaching reform driven by digital intelligence technology

3.1. Challenges of technology convergence and application

In terms of technological adaptability, the integration and application of various digital and intelligent technologies in education must consider compatibility, usability, and adaptability. Teachers and students require

time to familiarize themselves with new technologies, which may increase their learning burden. Given the rapid pace of technological advancement, ensuring that teaching platforms and technologies keep pace with the times and remain synchronized with the latest innovations presents a continuous challenge.

3.2. Data security and privacy protection

In terms of data security, the widespread adoption of digital and intelligent technologies in classroom teaching has led to the collection and analysis of massive educational data, raising concerns about data protection. This necessitates the establishment of stringent data security protocols and encryption technologies to safeguard students' and teachers' privacy. Regarding privacy protection, when collecting and utilizing student data, relevant laws and regulations must be strictly followed to ensure students' privacy rights are fully protected.

3.3. Teacher training and development

Teachers who properly recognize their evolving roles can better adapt to classroom digital transformation while enhancing their digital literacy and teaching capabilities. [10] They should receive professional training in digital intelligence technologies to improve their technical proficiency and instructional skills. The training should cover fundamental operations of digital intelligence technologies, instructional design, and teaching evaluation. The development of digital intelligence technologies presents both new opportunities and challenges for teachers' career growth. Educators must continuously update their knowledge and skills to adapt to new teaching environments and demands.

4. The practical path of digital intelligence technology enabling classroom teaching

4.1. Improve teachers' digital literacy

4.1.1. Strengthen the training mechanism of digital and intelligent technology

In the process of enhancing teachers' digital literacy, strengthening digital technology training plays a pivotal role. First, specialized training programs should be organized, inviting senior experts and scholars in the field of digital technology to provide comprehensive and systematic professional training for educators. The training content should cover fundamental theoretical frameworks, practical application cases, and strategies for deep integration of digital technology into teaching practices, aiming to comprehensively improve teachers' application capabilities. Additionally, to accommodate individual differences and needs, a flexible combination of online and offline training modes should be adopted, allowing teachers to choose participation methods based on their schedules and circumstances, thereby enhancing the relevance and effectiveness of training. Second, promoting self-directed learning is crucial. Teachers should be encouraged to utilize their spare time through various self-learning channels such as online courses and professional reading, to explore the knowledge system of digital technology. To effectively stimulate learning motivation, a well-designed reward mechanism should be established, recognizing and rewarding teachers who actively engage in learning and achieve significant results. This approach fosters a positive learning atmosphere, driving continuous improvement in teachers' digital literacy.

4.1.2. Promote innovation in digital and intelligent teaching practices

To drive innovation in teaching methodologies, educators should be encouraged to integrate digital and intelligent technologies into classroom instruction. First, we can pioneer new teaching models by promoting

the application of smart technologies in blended learning and project-based learning. By creating virtual experimental environments through these technologies, students can engage in hands-on exploration, which enhances their learning motivation and self-directed skills. Second, organizing digital education competitions can ignite teachers' creative enthusiasm and practical drive. These events showcase successful implementations of smart technologies in classrooms, fostering peer collaboration and knowledge exchange to collectively improve digital literacy and teaching effectiveness.

4.1.3. Promote the continuous improvement of teachers' digital literacy

To ensure the steady growth and continuous optimization of teachers' digital literacy, the following strategies should be strengthened. First, building learning communities: Actively promote the formation of teacher-led learning groups to share educational materials and pedagogical insights in digital technology. Through regular exchange seminars, foster collaboration and mutual support among educators, creating a vibrant learning environment and efficient cooperation framework. Second, maintaining a robust technical support system: Provide uninterrupted technical assistance and resource supply to ensure seamless integration of digital technologies into classroom education. To this end, establishing specialized digital technology consultation centers can offer immediate and effective technical support, addressing teachers' practical challenges in technology application.

4.2. Build a digital and intelligent teaching environment

4.2.1. Building smart campus infrastructure

Upgrade campus networks to ensure high-speed, stable, and secure connectivity. Deploy intelligent teaching devices such as smart blackboards and smart classroom systems to enhance interactive learning. Establish a robust campus network that supports seamless operation of all application systems. This includes optimizing network infrastructure with gigabit fiber optic access and achieving full coverage of wired and wireless WiFi in academic buildings and administrative offices. Develop digital teaching resources including textbooks, educational software, and lab equipment to meet online learning needs. Create online courses and curriculum repositories to provide diverse instructional materials for educators and students. Build an educational big data center to collect, store, and analyze teaching data, supporting precision teaching solutions.

4.2.2. Promote the construction of smart classrooms

To build a smart classroom ecosystem that enables intelligent delivery of teaching resources and automated classroom management. By integrating high-quality educational materials, we will establish a school-based digital repository to meet diverse needs of teachers and students. Developing interactive and generative digital resources powered by virtual reality and AI technologies will revolutionize classroom instruction. Teachers are encouraged to create digital teaching materials such as lesson plans and instructional videos, thereby enriching the resource library. The smart classroom system will facilitate blended online-offline teaching to enhance educational outcomes. Students are motivated to utilize digital technologies for self-directed and collaborative learning, fostering their innovative thinking and teamwork skills.

4.3. Improve digital and intelligent teaching evaluation

4.3.1. Establish a comprehensive digital and intelligent teaching evaluation system

Establish clear evaluation objectives that align with curriculum goals, teaching objectives, and assessment

criteria. Ensure these objectives reflect both students' learning outcomes and teachers' instructional effectiveness. Enrich the evaluation framework by enhancing foundational metrics such as learning situation analysis, individual learning goals, and competency assessments. Prioritize process-oriented indicators including resource accessibility, activity engagement, group discussion practices, and individual contribution to learning activities.

4.3.2. Promote innovation in digital and intelligent teaching evaluation

To diversify evaluation methods, we transition from single-dimensional assessments to multidimensional evaluations. This approach constructs "teaching" evaluation content through multiple dimensions including instructional behaviors, cognition, emotions, and wisdom, while building "learning" evaluation content through student responses, learning outcomes, learning abilities, and core competencies. By leveraging big data coding and artificial intelligence, evaluations become more diverse, comprehensive, and holistic. Emphasizing precision and objectivity, we drive the development of more accurate evaluation systems through digital-intelligent integration, enabling precise capture of all aspects of the teaching process. Evidence-based teaching evaluation based on multi-source data has become a future trend, eliminating subjectivity and arbitrariness to enhance the comparability and fairness of evaluation results. Stressing process-oriented and dynamic evaluations, traditional assessments focus on final student evaluations and peer reviews, whereas digital-intelligent teaching evaluations emphasize real-time tracking, dynamic assessment, and analysis of instructional behaviors. Utilizing digital-intelligent technologies to collect and analyze data in real-time provides evaluators with timely and accurate feedback, promoting innovation and improvement in teaching methods.

4.4. Strengthen digital and intelligent collaboration between home and school

4.4.1. Build a digital and intelligent home-school platform

As a crucial educational philosophy in modern school systems, home-school collaboration still faces challenges in practical implementation, often failing to deliver optimal outcomes. [11] Schools could adopt the "Jiang Xiao AI" home-school connectivity platform developed by Jianghan University's School of Artificial Intelligence, leveraging both internal and external technical resources to build customized digital platforms. These platforms should provide essential features including information integration, news subscriptions, data queries, and real-time communication tools, enabling precise digital education resource distribution. Furthermore, they should consolidate existing educational assets—such as online classrooms, automated grading systems, and homework management platforms—into a unified interface, allowing parents to monitor their children's academic progress at any time. Through this platform, parents can access detailed records of academic performance, competency assessments, and behavioral patterns, creating a comprehensive digital growth portfolio for each student.

4.4.2. Promote home-school information sharing

Schools should regularly update educational resources on the home-school platform, including course materials, homework assignments, and exam schedules, ensuring parents stay informed about school updates. Parents can also provide feedback on their children's academic performance and learning progress through the platform, offering comprehensive and accurate student data to the school. By leveraging digital intelligence technologies, schools can facilitate real-time data exchange between parents and students. For example, parents can monitor their children's classroom participation and homework completion status in real time via the platform. Schools can also use this feedback to make targeted adjustments and improvements to teaching content and methods.

4.4.3. Carry out digital and intelligent education activities

Schools can regularly organize digital and intelligent technology training programs to help parents master practical applications of these technologies, thereby enhancing their engagement in home-school collaboration. The training content may include platform operations, data analysis methods, and other relevant skills. For instance, organizing digital literacy competitions and programming contests can spark students' learning enthusiasm and innovation capabilities while fostering communication and cooperation between families and schools. By implementing diverse awards and incentive mechanisms, such competitions can effectively encourage active participation from both students and parents.

5. Future prospects of digital intelligence enabling classroom teaching

5.1. Personalized teaching

Personalized education refers to tailoring teaching content, methods, and pacing based on students' learning characteristics, interests, and abilities, thereby meeting individual needs and promoting holistic development. In the context of digital and intelligent empowerment, personalized teaching has become increasingly vital. It not only stimulates students' learning motivation and enthusiasm but also enhances teaching effectiveness and learning efficiency, laying a solid foundation for their future development. Through big data analysis and AI technologies, systems can accurately identify students' learning styles, interests, and competency levels, thereby providing customized learning paths and resources for each student. This personalized approach maximizes students' learning potential, fulfills diverse needs, and achieves tailored education that adapts to individual capabilities.

5.2. Innovation in teaching models

Digital intelligence technologies will drive the deep integration of online and offline education, creating a blended learning model. Students can engage in self-directed learning through digital platforms at home, while participating in hands-on activities, discussions, and collaborative projects at school. This approach breaks down barriers of time and space, enhancing learning flexibility and efficiency. These technologies provide abundant educational resources and creative tools that stimulate students' innovative thinking and capabilities. They enable interdisciplinary learning where students integrate knowledge from various fields to develop novel perspectives and solutions. Furthermore, digital intelligence technologies support more complex and in-depth project-based learning. Students investigate real-world problems or challenges using these tools for data analysis, simulation experiments, and creative expression. This learning approach cultivates critical thinking and problem-solving skills essential for future success.

5.3. New quality talent training

New-type talents—individuals equipped with innovative thinking, technical expertise, and interdisciplinary capabilities—are pivotal to advancing next-generation productive forces. In the digital intelligence era, the convergence, evolution, and upgrading of technological revolutions and digital technologies have driven industrial transformation and accelerated China's modernization. Consequently, professionals across all fields must develop robust digital competencies through digital education and technical training. Future education will increasingly emphasize cultivating comprehensive qualities that enable students to shape and lead future development, including growth mindset, human-machine symbiosis thinking, and pioneering spirit.

5.4. Create an intelligent disciplinary foundation platform and "AI+X" micro-specialization

The "AI+X" micro-specialization represents an innovative educational model designed to equip students with foundational AI knowledge and skills for interdisciplinary application. This framework emphasizes cross-disciplinary learning, enabling students to develop AI-powered solutions for complex problems in various fields. Typically comprising two modules—AI fundamentals and AI+X integration courses—these programs may cover specialized areas like "AI+Mathematics," "AI+Geography," "AI+Art," or "AI+Communication," with potential future expansion to all academic disciplines. For instance, East China Normal University's "AI+X" program focuses on integrating AI with core academic subjects, such as applying mathematics in AI development and digital image processing. Developed through collaboration between universities and tech companies, these micro-specializations ensure cutting-edge content and practical relevance. By leveraging digital intelligence technologies to enhance classroom instruction, the creation of intelligent academic platforms and "AI+X" programs will significantly advance educational modernization and talent cultivation. As technology evolves and educational reforms deepen, these fields are poised to unlock unprecedented growth potential. However, challenges including technological updates, resource allocation, and pedagogical innovation must be proactively addressed through strategic measures.

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