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The Logical Interpretation, Practical Dilemma and Practical Path of Digital Technology Enabling the Modernization of Education Governance

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Abstract

This systematic study explores theoretical and practical dimensions of digital technology's role in advancing educational governance modernization. The research demonstrates that digital technologies drive paradigm shifts in educational governance through data-driven approaches, intelligent systems, and collaborative mechanisms, transitioning from empirical practices to science-based precision models. However, implementation faces multiple challenges including data silos, operational disconnects, security risks, systemic barriers such as inadequate top-level design and regulatory lag, as well as human capacity constraints like digital formalism, competency gaps, and the digital divide. To address these issues, the paper proposes a dual technical strategy: establishing unified data infrastructures and promoting scenario-based integration while strengthening security safeguards. Concurrently, it advocates institutional reforms encompassing enhanced top-level design, innovative mechanisms, and improved legal frameworks. Additionally, it outlines three key human-centric approaches: enhancing digital literacy, fostering diverse ecosystems, and implementing inclusive strategies. Utilizing literature review and case analysis, the study constructs a "technology-institution-human" analytical framework to provide theoretical foundations and practical references for advancing educational governance modernization.

Keywords

digital technology; educational governance modernization; empowerment logic; real-world challenges; implementation pathways

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1. Introduction

With the advancement of the Digital China strategy and educational digitization initiatives, China's modernization of educational governance faces significant opportunities while confronting contradictions between traditional management models and high-quality development demands, urgently requiring digital transformation to enhance governance efficiency. Existing research predominantly focuses on the application of technology in teaching reforms or institutional policy analysis, yet

systematic exploration of the underlying logic of digital technology empowering educational governance and the "real-world dilemmas-practical pathways" remains insufficient. To address this gap, this paper employs literature review, case analysis, and logical reasoning methods based on collaborative governance, technology empowerment, and data-driven decision-making theories. It conducts systematic research around empowerment logic, real-world dilemmas, and practical pathways to fill existing research gaps, providing theoretical support and practical references for the modernization of educational governance[1].

2. Logical interpretation: the internal mechanism of digital technology enabling the modernization of education governance

The empowerment of educational governance through digital technology is not merely about superficial implementations like introducing software or platforms. It represents a profound systemic transformation that reaches the core of educational governance, evolving from within to without. The underlying mechanism operates through a progressive and logically unified process, collectively forming the driving force behind modernizing educational governance through digital technology.

2.1. Technology-driven: the basic support for paradigm change

Digital technology is transforming educational governance from "experience-driven" to "data-driven," enabling scientific and precise reforms[2]. First, datafication serves as the foundation for educational empowerment. Technologies like big data and IoT comprehensively collect teaching, learning, and resource data, converting educational phenomena into quantifiable information. This supports accurate assessment of student needs and resource efficiency, driving the shift from "empirical decision-making" to "data-driven" approaches. Second, intelligentization acts as the core engine[3]. AI and machine learning enable trend prediction, smart alerts, and personalized interventions—such as identifying dropout risks and delivering tailored resources—significantly enhancing governance's scientific rigor and foresight. Finally, collaboration and trustworthiness form the systemic safeguards. Cloud computing breaks down "information silos," facilitating cross-departmental data sharing and operational coordination. Blockchain technology ensures transparency in critical data like academic credentials and credits, strengthening credibility and supporting the development of lifelong learning systems[4].

2.2. Paradigm reconstruction: the core embodiment of enabling process

Driven by foundational technological advancements, the traditional paradigm of educational management is undergoing systematic transformation—a pivotal manifestation of empowerment. This evolution encompasses three dimensions: institutional entities, operational processes, and value systems[5]. Firstly, digital technologies are steering educational governance from "homogeneous" to "diversified" models. While governments historically held sole authority, modern platforms now enable diverse stakeholders—including schools, educators, students, and parents—to jointly participate in policy evaluation, management participation, and oversight implementation, fostering collaborative governance. Secondly, administrative workflows are transitioning from "vertical hierarchies" to "flattened structures" with closed-loop mechanisms[6]. Data platforms enhance decision-making scientific rigor; system logging and node monitoring ensure transparent policy execution; while online channels enable comprehensive public supervision. This evolution transforms processes from one-way chains into dynamic, agile, and efficient interactions. Thirdly, governance values have shifted from "efficiency-first" to "human-centered" principles. Digital empowerment redirects objectives toward education's core values: equitable access, quality-focused development, personalized growth, and holistic human development. Technology has evolved beyond being a control tool to become a powerful catalyst for nurturing well-rounded student development[7].

2.3. Value realization: the ultimate goal of enabling action

All technological and paradigm shifts ultimately aim

to achieve the core values of modernizing educational governance, specifically manifested in four aspects. First, digital technology significantly enhances governance efficiency. Applications like automated office systems and intelligent approval processes free administrative staff from repetitive tasks, enabling managers to focus on strategic planning and substantive development while optimizing human capital allocation[8]. Second, digital technology effectively safeguards educational equity. High-quality resources are now widely distributed to rural, remote, and underdeveloped areas, breaking down spatial-temporal barriers to bridge resource gaps. This effectively narrows disparities between urban-rural, regional, and school-level levels, providing fairer educational opportunities for every student. Third, big data supports optimized resource allocation. Through dynamic monitoring and forecasting of supply-demand relationships in teaching staff, equipment, and funding, educational management transitions from "reactive response" to "proactive adaptation." This enables precise resource deployment, prevents idle waste, and maximizes efficiency through optimal resource distribution[9].

3. Realistic Dilemma: Challenges and Obstacles of Digital Technology Empowering Education Governance

While digital technology has painted an inspiring vision for modernizing educational governance, its implementation faces multifaceted and profound challenges. These intertwined obstacles reinforce each other, forming a complex challenge system that could lead to "high investment with low efficiency" if not properly addressed. Specifically, these roadblocks primarily manifest in three core dimensions: technological infrastructure, institutional frameworks, and human capacity development[10].

3.1. Technical bottleneck: the dual constraints of application depth and security risk

Technology serves as the foundation for empowerment, yet its inherent immaturity and inadequate adaptation to application scenarios pose immediate obstacles. The current education data landscape grapples with a prominent "data silo" issue. Educational institutions and departments at all levels operate systems with inconsistent technical architectures and varying standards, resulting in ineffective data sharing and the formation of numerous "data chimneys" that struggle to converge into a unified data lake. Fragmented data hinders comprehensive analysis and intelligent decision-making, leading to wasted data value and governance efforts trapped in a "blind men touching an elephant" dilemma[11]. Furthermore, there exists a disconnect between technology and business operations, with insufficient empowerment. Digital tool development often neglects real-world operational needs—prioritizing hardware over applications and technology over business requirements—resulting in poorly adapted functions and cumbersome operations that burden grassroots units. Many systems become mere decorations or advanced data entry tools, delivering low input-output efficiency and causing resource waste[12]. Lastly, weak security mechanisms heighten data privacy risks. Sensitive information involving minors' personal details and academic records lacks rigorous technical safeguards and institutional norms, with inadequate encryption, anonymization, and auditing. Risks of unauthorized data collection beyond authorized scopes, uncensored disclosures, and internal/external leaks persist, potentially triggering privacy breaches and social trust crises that severely constrain data sharing and value realization.

3.2. Institutional lag: the lack of systematization of top-level design and policies and regulations

Traditional institutional systems exhibit inherent inertia, with their renewal pace failing to keep pace with the rapid iterations of digital transformation, creating deep-seated systemic barriers. This manifests in three major challenges: First, the absence of top-level design and standardized norms. The lack of coordinated planning and unified standards for data, interfaces, quality, and security at national and regional levels has led to fragmented implementation across regions, resulting in redundant construction, system incompatibility, and exacerbating the "data silo" dilemma. Second, rigid institutional barriers. The traditional hierarchical management model fundamentally conflicts with the flat, cross-departmental collaboration required for digital governance. Unclear departmental responsibilities, severe interest

fragmentation, low willingness to share data, high costs, and the "nine dragons managing water" bureaucratic inefficiency hinder technological empowerment. Third, lagging policy updates. Existing education policies and evaluation systems fail to adapt to digital demands, lacking clear legal definitions for key issues like data ownership, digital identity, and online education legitimacy. These gaps restrict innovative practices and dampen reform vitality[13].

3.3. Literacy and the Gap: Deep challenges to subject competence and social equity

Ultimately, the realization of technology's transformative potential hinges on human agency. The most fundamental challenge lies in the mindset and capabilities of governance stakeholders, manifested through four critical dimensions: First, rampant "digital formalism" keeps transformation confined to technical implementation. Rather than driving process innovation and decision-making reforms, measures like digital tracking and mandatory check-ins burden frontline staff, distorting the essence of empowerment. Second, insufficient digital literacy among governance entities creates systemic bottlenecks. Many administrators and educators lack data-driven thinking and tool proficiency, resisting data-driven decision-making while resisting new technologies. Third, the "digital divide" exacerbates inequality. Significant disparities in infrastructure, equipment, and professional expertise across regions, urban-rural divides, and school systems leave under-resourced institutions struggling with transformation costs. Digital technologies thus widen developmental gaps, deviating from equitable goals. Fourth, inadequate public engagement channels hinder transparency. The absence of accessible platforms for public oversight undermines citizens' rights to information and supervision. Meanwhile, insufficient awareness campaigns have prevented the formation of a collaborative governance ecosystem, constraining democratic and open decision-making processes[14].

4. Practical Path: Promoting the systematic approach of digital technology to empower the modernization of education governance

In the face of multiple challenges in modernizing educational governance through digital technology, piecemeal fixes have proven ineffective. A systematic approach is imperative, requiring coordinated efforts across three dimensions: technological infrastructure, institutional environment, and human capacity. This calls for building an integrated framework that synergizes these elements, transforming digital technology from fragmented "instrumental applications" into comprehensive "systemic empowerment".

4.1. Technology breakthrough and integration: build a solid, trusted and intelligent enabling base

The technological roadmap aims to establish a reliable, secure digital infrastructure deeply integrated with education, ensuring that technology is "usable, user-friendly, and trustworthy." The primary task involves creating a unified, standardized data foundation to eliminate "data silos." The government will lead in formulating unified data standards and interface specifications, establishing a national education data hub platform to comprehensively integrate data from various systems. This will achieve "one source, multiple uses" and transform "data silos" into high-quality "data lakes," providing accurate and comprehensive data support for intelligent decision-making. Secondly, we will promote deep integration between technology and business operations to prevent "disconnected systems." Focusing on core scenarios, we will develop intelligent and customized tools embedded in actual workflows to address governance pain points, enhance precision and efficiency, and truly empower educational governance through technology. Finally, a comprehensive security and trust protection system will be built. Technologically, encryption, desensitization, and privacy computing will be applied to achieve "data availability without visibility," while blockchain will be utilized for critical information certification and traceability. Strict permission controls and audit mechanisms will solidify trust foundations, ensuring compliant and efficient data utilization[15].

4.2. Institutional innovation and guarantee: building a policy environment with leading norms and incentive compatibility

The core of institutional pathways lies in establishing

clear rules, sustained momentum, and stable expectations for educational digital transformation through top-level design, mechanism innovation, and legal system development, systematically breaking down institutional barriers. First, strengthen top-level design and strategic guidance. The state should issue policy documents outlining strategic goals, technical roadmaps, and responsible entities for the next 5-10 years, guiding local governments to advance reforms under a unified national framework while avoiding redundant construction and inconsistent standards, thereby enhancing overall coordination. Second, innovate institutional mechanisms and evaluation systems. Establish an interdepartmental "Education Data Governance Committee" to coordinate data sharing and operational collaboration. Incorporate data governance capabilities and application effectiveness into government performance evaluations, school assessments, and cadre appraisals, creating incentive mechanisms that "promote development through evaluation and drive implementation through assessment" to stimulate internal motivation across all stakeholders. Finally, improve legal frameworks and standardization systems. Accelerate legislation to define data rights and responsibilities, providing legal foundations for openness, circulation, and security. Refine technical, security, and ethical standards, establish multi-stakeholder collaborative governance rules, and promote resource sharing and coordinated governance efforts.

4.3. Quality improvement and inclusive development: Cultivating governance culture and capacity adapted to the digital era

The human path aims to enhance digital literacy for all stakeholders while ensuring equitable benefits. First, implement differentiated digital literacy enhancement programs. Provide data decision-making and strategic leadership training for managers, strengthen tool application and data interpretation skills for teachers and administrators, and foster an organizational culture of "data-driven decision-making" to make data thinking a fundamental competency. Second, build an open collaborative governance ecosystem. Utilize digital technology to establish public participation platforms, safeguarding parents 'and society's rights to information, participation, and oversight. Encourage enterprises and think tanks to engage in application development and consulting, forming a co-construction and co-governance framework of "government leadership, market participation, and social collaboration." Finally, promote inclusive digital strategies. Increase investment in digital infrastructure for rural and impoverished areas, ensure network and terminal coverage, provide continuous digital skills training and support, prevent the widening of the "digital divide," ensure disadvantaged groups share technological dividends, and advance educational equity.

Disclosure statement

The author declares no conflict of interest.

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