

The Logical Interpretation and Practical Path of Digital Technology Enabling Balanced Development of Urban and Rural Education

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Abstract

With the deep integration of digital technologies such as 5G, artificial intelligence, blockchain, and the Internet of Things (IoT) into education, the digital transformation of education has opened new opportunities to address the imbalance between urban and rural education. Digital technologies not only break geographical barriers and facilitate cross-regional distribution of quality educational resources, but also reshape rural teacher training models, cultivate local talent capital, and innovate cultural communication methods in rural areas, injecting fresh momentum into balanced educational development. This article systematically explores the underlying logic of how digital technologies empower equitable education development across urban-rural divides within the context of educational digitalization. It analyzes practical challenges encountered in implementation and proposes targeted optimization strategies through case studies from multiple regions nationwide. These insights aim to provide references for advancing rural education revitalization and building a strong educational nation.

Keywords

Digitalization; Digital technologies; Urban-rural education; Balanced development

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1. Introduction

The report of the 20th National Congress of the Communist Party of China clearly states that education, science and technology, and talent form the foundational and strategic pillars for comprehensively building a modern socialist country. It emphasizes prioritizing educational development, accelerating the construction of an education powerhouse, while advancing educational

digitalization to build a lifelong learning society and a learning-oriented nation^[1]. As a crucial component of building an education powerhouse, the high-quality development of rural education directly impacts the realization of national educational modernization. Currently, China has preliminarily completed the transition from basic balance to quality balance in urban-rural education. However, rural education still faces core

challenges such as scarce digital educational resources and a shortage of excellent teachers. Traditional east-west pairing assistance models and cross-regional resource allocation fail to meet the sustained and tailored service demands of rural education. Therefore, systematically elucidating the intrinsic logic of how digital technology empowers balanced urban-rural education development, soberly recognizing its current challenges, and scientifically planning future implementation pathways hold significant theoretical value and urgent practical significance^[2].

2. The logical interpretation of digital technology enabling balanced development of urban and rural education

Empowering balanced development of urban and rural education with digital technology is an inevitable choice to follow the trend of educational digital transformation and promote rural education revitalization and the construction of an education power. Its internal logic lies in two aspects: value logic and system construction logic.

2.1. Value logic: multi-dimensional solution to the problem of urban and rural education imbalance

First, breaking down geographical barriers to optimize resource allocation. Digital technologies have overcome the spatial constraints of traditional education, delivering high-quality urban educational resources to rural areas through models like “Synchronous Classrooms,” “Digital Teaching Support,” and “Air Classroom.” For instance, Gansu Province’s “Digital Teaching Support” initiative, in collaboration with eight teacher-training universities, offers courses in English, music, and art to 16 national key counties for rural revitalization. These programs cover 341 primary and secondary schools, benefiting 504,600 students and effectively addressing the chronic shortage of teachers and courses in rural schools. Meanwhile, smart education platforms and digital libraries enable rural students to conveniently access massive course resources, reducing learning costs while enriching educational content. This transformation shifts resource allocation from one-way transmission to two-way circulation^[3].

Second, by deepening human resource development, we can activate the internal driving force of rural education. Teachers are the key to rural education development, and digital technology has restructured teacher training models, providing new pathways for their professional growth. The blended training model combining “asynchronous research + synchronous collaboration + demonstration classes” enables rural teachers to independently study teaching resources from master educators, interact through live online sessions, and observe exemplary classrooms—all achieving deep integration of theoretical learning and practical application. For instance, a teacher development program covering 20 counties across 14 provinces and municipalities conducted activities via a digital platform, engaging 4,297 rural backbone teachers. This initiative not only enhanced their subject-specific teaching skills and online research capabilities but also cultivated a stable team of high-quality rural educators. It established a sustainable development mechanism of “urban support + rural self-sustaining,” injecting intrinsic motivation into rural education^[4].

2.2. System logic: Build a system of high-quality and balanced development of urban and rural education

First, technology enables the construction of a digital ecosystem to ensure cross-regional resource supply. The digital ecosystem serves as the foundational support for resource mobility across regions, encompassing three aspects: hardware infrastructure, software platforms, and technical services^[5]. On the hardware front, efforts should focus on strengthening digital infrastructure in rural schools, achieving full coverage of high-speed educational networks and complete provision of digital teaching equipment to support remote teaching research and model classrooms. On the software front, specialized digital training platforms should be developed to aggregate national master teachers’ resources, supporting asynchronous teaching research, real-time interactive functions, and providing data statistical analysis services to precisely match rural education needs^[6].

Second, organizational evolution involves establishing educational communities and promoting multi-party collaboration. To achieve balanced urban-rural education development, it is essential to break down barriers between stakeholders and form a collaborative

network comprising “national administrative departments + funding providers + county-level project teams + master teacher teams + rural teachers”. National authorities coordinate the formation of master teacher teams and provide technical support, while funding providers ensure resource allocation. County-level project teams manage rural backbone teachers and disseminate teaching research achievements, with master teacher teams offering high-quality courses and guidance, and rural teachers implementing these outcomes at the county level. Each stakeholder fulfills their role through coordinated efforts. For instance, in the Teacher Teaching Research Enhancement Project, master teacher teams conducted 1,437 lectures, while county-level project teams expanded the impact of research achievements. This creates an operational mechanism combining “internal circulation + external outreach + collaborative synergy”, effectively addressing the traditional “supply-demand mismatch” issue in educational assistance^[7].

Thirdly, content innovation restructures professional development models to bridge theory and practice. To address rural teachers’ challenges in absorbing theoretical knowledge and translating it into practical applications, digital technology implements a three-pronged approach: “asynchronous research + synchronous collaboration + model classrooms”. Asynchronous research empowers rural teachers to independently study and refine teaching issues, while synchronous collaboration focuses on problem-solving and overcoming key challenges. Model classrooms provide practical case studies and operational frameworks. This progressive triad transforms expert resources from one-way input to two-way interaction. Furthermore, the curriculum integrates interdisciplinary teaching and inquiry-based learning concepts aligned with new curriculum standards and college entrance exam reforms, modernizing rural teachers’ pedagogical approaches. This transformation ultimately enhances students’ subject competencies, cognitive thinking, and digital literacy through multidimensional development^[8].

3. Practical challenges of digital technology enabling balanced development of urban and rural education

Although digital technology provides new opportunities

for the balanced development of urban and rural education, there are still challenges in infrastructure, subject literacy, platform resources, management mechanism and other aspects in the process of implementation, which restricts the full release of the effectiveness of digital technology.

3.1. Weak infrastructure and lagging digital ecology construction

Rural areas face dual challenges of “insufficient supply” and “delayed modernization” in digital infrastructure. On one hand, many remote schools lack adequate teaching equipment with outdated performance, struggling to support large-scale remote learning and research activities. Issues like network lag causing classroom delays and noise pollution negatively impact teacher-student interaction quality. On the other hand, inadequate funding for infrastructure maintenance prevents equipment updates from keeping pace with technological advancements. Additionally, low internet coverage and slow speeds in some regions hinder access to digital resources. Furthermore, the low ownership rate of digital devices among rural households means many students lack learning terminals to participate in online education, further exacerbating the digital divide^[9].

3.2. The main body’s digital literacy is insufficient and the enthusiasm for participation is low

Teachers and students are the core participants in digital education, with their digital literacy directly impacting learning outcomes. At the teacher level, some rural educators hold outdated educational philosophies and demonstrate inadequate acceptance and application skills of digital technologies, exhibiting reluctance to adopt new methods or lack of proficiency. Meanwhile, burdened by multiple roles and heavy workloads, most rural key teachers cannot participate in synchronized teaching-research activities due to scheduling conflicts, limiting them to watching recorded sessions which undermines learning effectiveness. On the student side, rural learners have long been confined to relatively isolated environments, lacking awareness of self-directed learning through digital tools. Many students also struggle with basic digital skills, making it difficult for

them to effectively utilize online learning platforms and resources, ultimately resulting in suboptimal academic performance^[10].

3.3. The platform functions are not perfect, and the resource adaptability is insufficient

Current digital education platforms suffer from both functional limitations and resource misalignment. Functionally, most platforms focus primarily on content storage and playback, lacking interactive features, data analytics, or personalized recommendations. This leaves teachers unable to accurately track student progress through these platforms, while students struggle to access customized learning materials. Regarding resources, most platforms are designed for urban educational needs, showing poor alignment with rural students' learning contexts and local cultural characteristics. Additionally, certain subject areas like arts and physical education face resource shortages, creating a mismatch between supply and demand that hinders effective implementation of high-quality materials^[11]. Furthermore, poor platform compatibility and cumbersome courseware conversion processes result in underutilized resources developed by expert educators, leading to significant resource waste.

3.4. The management mechanism is not perfect and lacks long-term guarantee

The imperfections in project management and evaluation mechanisms undermine the sustainability and effectiveness of educational initiatives. Firstly, the absence of demand alignment mechanisms leaves urban master teacher teams inadequately informed about rural learning contexts and teaching cultures, resulting in resource allocation that fails to meet the specific needs of rural education^[12]. Secondly, evaluation systems remain overly simplistic, predominantly focusing on "time spent on learning" and "point accumulation" without addressing teachers' professional development or students' holistic growth. Moreover, these evaluations show minimal correlation with teachers' performance or career advancement, failing to motivate educators. Thirdly, the outreach mechanism proves weak: rural backbone teachers' capacity-building potential remains underutilized, with support primarily provided through sporadic, ad-hoc initiatives that lack systematic cultivation for county-wide educators,

ultimately preventing the project's benefits from achieving widespread dissemination.

4. Practical paths for digital technology to empower balanced development of urban and rural education

In combination with theoretical logic and practical challenges, it is necessary to put forward targeted strategies from four dimensions: infrastructure, subject literacy, platform resources and management mechanism, so as to promote the deep integration of digital technology and urban and rural education and realize high-quality and balanced development.

4.1. Consolidate digital infrastructure and improve the support of digital ecology

On one hand, governments at all levels should increase funding and optimize hardware configurations. They must incorporate digital infrastructure development for rural education into fiscal budgets, intensify financial investments to equip schools with complete digital teaching facilities (including smart terminals and multimedia classrooms), upgrade network infrastructure to achieve full coverage of high-speed educational networks. Simultaneously, establishing regular equipment renewal and maintenance mechanisms will ensure that hardware remains compatible with the demands of digital education^[13].

On the other hand, we should introduce advanced practices to upgrade educational facilities. By strengthening collaboration with international organizations and developed countries, we can adopt cutting-edge digital education infrastructure concepts and technologies. For instance, by leveraging mixed reality (MR) technology to create immersive virtual-reality teaching environments, we can facilitate the transition of rural education from "traditional classrooms" to "smart classrooms". Simultaneously, tailored infrastructure models that are "cost-effective and easy to maintain" should be explored based on local conditions. This approach avoids blindly pursuing high-end equipment while ensuring the practicality and sustainability of educational facilities.

4.2. Improve the digital literacy of teachers and students and stimulate their internal motivation to participate

On one hand, implementing tiered and categorized training programs to enhance teachers' digital competencies. Tailored training plans are designed for different groups: principals and administrators receive focused training on digital management concepts and platform operation skills; core teachers focus on practical abilities such as digital instructional design and online interaction techniques; while general teachers undergo basic digital skills training including platform operations and courseware creation. Meanwhile, digital literacy is integrated into teacher evaluation systems, linked to performance assessments and professional title promotions to motivate learning enthusiasm. Additionally, regular guidance is provided to rural teachers through initiatives like "Mentorship Programs" and "Urban-Rural Pairing," fostering the integration of theory and practice^[14].

On the other hand, innovating teaching models to cultivate students' digital literacy. Integrate digital literacy education into curricula by offering information technology courses that teach students how to use digital tools, evaluate information sources, and ensure cybersecurity. Meanwhile, leverage digital technologies to transform teaching methods through project-based learning and interdisciplinary approaches, guiding students to solve real-world problems using online resources while fostering self-directed learning and innovative thinking. Additionally, organize digital skills competitions and tech events to spark students' interest in digital technologies, enhancing their application capabilities and creative problem-solving abilities.

4.3. Optimize the functional design of the platform and improve the adaptability of resources

On one hand, we will enhance platform functionalities and strengthen service capabilities. By upgrading the digital education platform with modules such as interactive communication (e.g., online Q&A, group discussions), data analytics (e.g., learning behavior analysis, academic performance diagnosis), and personalized recommendations (e.g., resource delivery based on

students' learning progress), we aim to achieve end-to-end services covering resource provision, instructional support, and evaluation feedback. Simultaneously, we will improve platform compatibility by supporting multi-format courseware uploads and conversion to resolve resource accessibility issues. Additionally, developing a mobile application will enable teachers and students to access the platform anytime, anywhere, significantly enhancing user convenience^[15].

On the other hand, we should integrate high-quality resources to enhance supply-demand alignment. By establishing a coordinated resource development mechanism between urban and rural areas, we can organize urban master teachers and rural educators to collaboratively develop educational materials. These resources should be tailored to local learning contexts and cultural characteristics, such as incorporating rural folk customs and agricultural knowledge into curriculum design to improve adaptability. Simultaneously, we need to establish a review and update system for resources, regularly curating premium content while phasing out outdated materials. Additionally, we should supplement scarce subject resources like arts, physical education, and vocational training based on rural educational needs. Furthermore, promoting cross-regional resource sharing through the creation of a national resource repository will facilitate efficient cross-regional circulation and utilization of quality educational resources.

4.4. Improve the management and evaluation mechanism to ensure long-term development

First, establish a demand alignment mechanism to achieve targeted support. Develop a "village needs research + urban resource customization" process by regularly collecting feedback from rural schools, teachers, and students through questionnaires and field interviews, then compiling these into detailed needs lists for expert teams. These teams will visit rural schools to assess teaching culture and student conditions, designing customized educational resources and research plans. Simultaneously, implement a two-way feedback system where rural educators and students provide regular assessments of resource utilization and improvement suggestions. This dynamic adjustment mechanism prevents supply-demand mismatches by ensuring continuous optimization of

resources and activities.

Second, innovate evaluation and incentive mechanisms to motivate stakeholders. Establish a diversified assessment system that evaluates both process and outcomes. Process evaluations focus on teacher engagement and resource utilization frequency, while outcome assessments emphasize faculty capability development (e.g., teaching effectiveness, student performance) and student competency growth (e.g.,

subject expertise, digital literacy). Evaluation results will be directly linked to teachers' performance, promotion opportunities, and awards, with outstanding performers receiving bonuses and training opportunities as incentives. Additionally, the "Rural Education Digital Innovation Award" will be established to encourage schools and teachers to explore new models of digital technology application, thereby stimulating innovative vitality.

Disclosure statement

The author declares no conflict of interest.

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