Bridging the Digital Divide: Policy Initiatives for Sustainable Digital Infrastructure Development in India

Dr. Anjali Shokeen and Ms. Neha Singh

School of Education, Guru Gobind Singh Indraprastha University, India

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ABSTRACT

In today's era of digital education, one of the basic needs of educators and teacher educators is Digital infrastructure. The Ministry of Education, Government of India, has taken many innovative steps to develop a learning platform. A well-structured infrastructure motivates the learner facilitates modern teaching methods, and enhances academic and personal development. Digital Infrastructure refers to educators' and students' electronic devices, hardware, data centers, and internet connectivity. Globally, to make students competent, there is a need for them to have adequate resources, including digital devices, internet connectivity, and trained educators. In the year 2019, during pandemic people understood the importance of digital infrastructure for access, continuity in education, health, business and social connectivity. NEP 2020 policy emphasizes establishing an open public digital infrastructure and improving digital connectivity to ensure equity in digital education. The study assesses the government policies and initiatives in addressing India's digital divide and equitable access to digital technologies. It explores opportunities and challenges associated with the availability of digital devices, reliable internet connectivity and government initiatives to promote digital infrastructure in education. The findings highlight the contribution of government initiatives towards digital inclusion while identifying persistent barriers that limit equitable participation. Addressing these gaps requires sustained investment, effective policy implementation, and targeted support for underserved communities.

Keywords: Digital infrastructure, NETF, digital education, DPI

INTRODUCTION

Digital Infrastructure and development in the field of Education in India

Digital infrastructure in the education field refers to the availability of technology and supporting systems that promote digital learning. It is one of the most important media in digital transmission. Digital transmission involves the transfer of analog signals into digital signals. Infrastructure includes the availability of adequate space for electronic devices, electricity, digital devices (hardware and software), and internet connectivity. Systems or devices are installed in schools, but due to limited availability of electricity and no internet access a gap is created between the marginalized and privileged groups. The government has launched many digitization initiatives to provide quality education to students, based on equity, access, and quality. Different government plans and schemes help students access digital education without discrimination based on low income or marginalization. PM e-Vidya provides nearly 25 crore school students education across the country. SWAYAM is an online course platform that helps students access education from class 9 to post-graduation; the DIKSHA platform is a portal and mobile application that stores e-books and e-content to help students acquire knowledge digitally. NDEAR (National Digital Education Architecture), e-pathshala, and virtual labs are government initiatives to ensure equitable access to digital education and help students globally competent. NEP 2020 also emphasizes digital learning which empowers society and knowledge engagement. Digital learning enhances students' involvement, removes language barriers, geographical barriers and brings inclusivity in our education system.

Digital India Program- Digital India was launched by Prime Minister Narendra Modi in the year 2015 to connect rural areas of India and improve digital literacy. Through common service centers this program provides rural India with digital empowerment and promotes a knowledge-based economy. DigiLocker is also a Digital India initiative that focuses on a paradigm shift from paper-based to paperless processes.

Digital Public Infrastructure - Digital Public Infrastructure (DPI) refers to the basic digital systems that help governments and businesses provide services to people easily and fairly. These systems include things like digital identity (such as Aadhaar), online payments (like UPI), and data-sharing platforms (such as India Stack). They provide a common digital foundation that lets services such as banking, education, healthcare, and government services connect and function smoothly. DPI helps make public services faster, more transparent, and more accessible to people.

REVIEW OF RELATED LITERATURE

(Zawacki-Richter & Jung, 2023) This handbook emphasizes the increased impact of distance education after the 2019 pandemic.The study suggests digital education is a multidimensional concept. It includes more than joining online platforms, digital infrastructure and integration of technology in education. **(Gurram, 2008)** This paper focuses on the importance of the Distance Education Council as an apex body and coordinating distance education, research and technology is one of the strength of distance education that promote relevance, equality and excellence in the knowledge enhancement sector. In India. **(Srivastava et al., 2020)** conducted a content analysis of 191 research articles published in 11 prominent peer-reviewed journals between 2010 and 2019 to examine research trends in Open and Distance Education (ODE) in India. The study analysed research areas, methodologies, authorship patterns, institutional affiliations, and publication trends. The study concluded that stronger institutional research policies, increased funding, enhanced collaboration, and greater publication in international journals are essential to strengthen the ODE research ecosystem in India. **(Ashtikar & Manoharan, 2025)**The study explores the role of digital innovation in sustainable infrastructure expansion. It focuses on qualitative, exploratory research on digital technologies that help bridge gaps and promote environmental sustainability and inclusive economic growth. The findings suggest that digital technologies support sustainable development and economic development but there is a need for inclusive digital policies and digital innovation alone does not support sustainable economic development. **(Njoku et al., 2025)** This paper examined the effect of digital connectivity infrastructure on a country's economic growth providing employment opportunities and access to education especially among marginalized communities. At the end the study recommends expanding broadband infrastructure, strengthening public-private partnerships and ensuring equitable digital inclusion for sustainable development. **(Pasupuleti, 2024)** This paper explored strategies to minimize digital inequality barriers in rural and low-income communities and also synthesized evidence from international experiences including Latin American, Sub-Saharan African and Indian. **Jain and Khokher (2024)** The study examined the existing educational landscape, digital infrastructure, government initiatives, and technological interventions aimed at improving educational inclusion and students' achievement in rural communities. The authors also discussed several national initiatives such as **BharatNet**, **Digital India**, **PMGDISHA**, **DIKSHA**, **PM e-Vidya**, and **K-YAN**, as well as public-private partnership models that strengthen digital education. **(Mukherjee, 2025)** This paper addresses the digital inequalities in India. The Digital divide is a significant barrier to socio-economic progress. The study identifies around 600 million citizens in rural areas lacking internet access. This paper investigated how technology can bridge this gap and promote inclusive growth. The study identified that despite many efforts including Digital Saksharta Abhiyan and mobile learning initiatives, India still lacks digital infrastructure availability and digital literacy; a lack of awareness about government schemes and policies among people still exists. **Murmu (2025)**. This paper highlights that there is disparities in digital literacy, internet access, online education, and government initiatives. The findings revealed that the disparity in digital inequality is due to several reasons such as geographical location, socio-economic status, gender, language and digital infrastructure. The study also emphasizes that there is uneven deployment of digital initiatives such as BharatNet, PMGDISHA and common service centers. At the end, the author concluded that there is a need to focus on intersectional policy frameworks, provide multilingual digital content and collaborate with different stakeholders to ensure equitable participation in India's knowledge economy and sustainable development. **(Dubey et al., 2024)** The paper examines the digitalization role in promoting equitable growth and

development in India. The author highlights the initiatives of the government to promote digital access and public services such as **Digital India, UPI, Aadhaar, PMJDY, BharatNet, PMGDISHA, PM e-Vidya, and digital healthcare initiatives**. But a digital divide remains with infrastructure gaps across rural and urban regions. The author proposes initiatives to strengthen digital infrastructure and connectivity. **Figueredo Jr. and Silva (2026),** through a systematic review of 85 studies, examined the major challenges of integrating digital services within administrative systems. Institutional and organizational barriers emerged as the most prevalent, while economic and infrastructure constraints were particularly significant in lower-development contexts. The study also emphasized that digital challenges vary according to socioeconomic context and therefore require context-specific strategies.

Digital infrastructure for knowledge sharing(DIKSHA) is one of the initiatives of NCERT in 2017. It is an online platform to provide freedom and choice to teachers and learners. The slogan is One Nation and One Digital Platform and it is adopted by almost all states of India.

Statement of the problem- Hence, based on the above discussion the subject to be selected for the investigation is stated as Bridging the digital divide: Policy initiatives for sustainable digital infrastructure development.

Objectives of the study

- How government interventions reduce digital inequalities through different policy initiatives?
- To examine the opportunities and challenges associated with the availability of digital devices and connectivity issues across rural and urban regions.

METHODOLOGY

The methodology of the study focused on a qualitative approach and analysis of secondary data to assess the government policies and strategies in promoting digital learning and digital Equity in India. The study explores the secondary data sources to understand the importance of digital literacy which facilitates equitable access to educational resources and digital services. The study also explores the significance of digital education in an increasingly technology-driven and competitive society. It also identifies persistent challenges in digital development, including disparities in digital infrastructure, inadequate access to digital devices and reliable network connectivity, geographical inequalities, language barriers, and differences in digital literacy. Through examining government policy initiatives and objectives the researcher develops an understanding of the opportunities and limitations of India's digital inclusion efforts.

Initiatives to reduce digital inequalities

Digital Infrastructure Development

- BharatNet
- Amended BharatNet
- National Broadband Mission 2.0
- 4G Saturation Project

Affordable and Accessible Connectivity

- PM-WANI (Pradhan Mantri Wi-Fi Access Network Interface)
- FTTH(Fiber to the home) through BharatNet
- Digital Bharat Nidhi

Digital Literacy and Skill Development

- Digital skills and capacity building
- Community grassroots digital training
- Digital literacy programs
- Community-based digital training

Digital Inclusion in Education

- Rural school broadband connectivity
- PM e-Vidya (DIKSHA, SWAYAM, SWAYAM Prabha and others)

Inclusive and Equitable Digital Governance

- Common Service Centers (CSCs)
- Social equity-targeted digital support
- Multilingual digital inclusion
- **Samriddh Gram Phygital Services Pilot**

Some other initiatives of the government are:

- Digital India Mission- A flagship initiative aimed at transforming India into a digitally empowered society by improving digital infrastructure, internet connectivity, and online services.
- National Cyber Security Policy 2013- It is a foundational framework to protect sensitive data through private and public partnerships. Introduced to safe critical data information.
- Information Technology Act 2000- The primary law governing cyber activities in India, addressing cybercrimes, electronic transactions, and digital security.
- Indian Computer Emergency Response Team- A national agency responsible for monitoring cyber threats, issuing alerts, and responding to cybersecurity incidents.
- Digital Personal Data Protection Act 2023- Ensures protection of personal data and promotes secure digital platforms and responsible data handling.
- India AI Mission- Supports AI development, digital innovation, and advanced technological infrastructure.
- National Education Policy 2020- Promotes the integration of digital technology, online learning, and cybersecurity awareness in education.
- Pradhan Mantri Gramin Digital Saksharta Abhiyan - The vision of this abhiyan is to enhance digital literacy among rural people. Almost 6 crore rural people get digital education.

Significance of the study

The Digital divide is one of the challenges facing countries and affects sustainable national development. In this competitive era there is a need to provide basic internet accessibility from urban to rural areas. Jain and Khokher (2024), The authors highlighted substantial infrastructural barriers to online education. Their analysis reported that approximately 87% of rural schools had electricity, while 42.15% had computer facilities and only 28.96% had internet connectivity. National Education Policy 2020 emphasizes Universal Digital Education where there is no discrimination and equality in digital education whether it is related to women and girls, and also provides equal opportunity to each individual without discrimination on the basis of a person's background or location. Through Continuous and comprehensive evaluation, the NEP 2020 policy focuses on improving the quality of teachers in digital education. It also sets up the NETF (National Education

Technology Forum) to focus on innovative ideas and collaboration in EdTech, and it provides evidence-informed policy advice for the Government of India to improve digital education. Sharma and Pattanayak (2023), underscore that digital education is important not merely to facilitate teaching and learning but also to reduce educational inequalities. Technology-based education brings more interaction from learners' side and also creates new learning opportunities to learners or teacher educators.

Challenges related to providing digital connectivity

In this competitive world, we all know that digital education is very important to compete with our competitors at the global level and to survive in our society in terms of digital knowledge, utilization of digital platforms, access to education and removing the barrier of the digital divide. The Government of India recognizes the need to promote digital learning for our young generations and for the country's growth and development. We still need to build students' confidence in choosing digital learning platforms, strengthen policies to protect student privacy, and reduce AI costs to promote digital learning. As courses begin to bridge the digital divide, they face difficulties because learners vary widely. It is necessary to investigate and design the obstacles specifically related to learner feedback and assessment. Empirical data is essential to support open education Models.

The available challenges can be identified only if we understand the need and importance of digital infrastructure in our lives. There are a number of challenges available; let's recount some of them:

Technology barrier- The companies update their software time to time, due to lack of awareness and internet access may create a hindrance to access and quality usage. Inadequate broadband connection, high Internet costs, limited digital literacy, and unequal access between urban and rural communities, poor network connectivity and outdated technological facilities restrict the participation of individuals in sustainable digital inclusion.

Legal and licensing barriers- These barriers may create difficulties to educational institutions that have limited financial resources. There is a need to prepare copyright rules that do not create any form of financial or accessibility barriers or they may discourage the learner from adopting digital education in learning.

Digital Inclusion gaps- India is a diverse country in terms of geographical location, language and gender disparity. Due to limited internet connectivity, inadequate digital infrastructure, and less availability of electricity in rural areas the digital divide is influenced and creates a gap in digital equity inclusion.

Financial issues - To increase the accessibility of digital infrastructure there is a need to generate funds from the government so that most of the educational institutions can access digital education software and access the internet in low cost. It also includes electricity supply, information and communication technology (ICT) infrastructure, digital platforms, technological equipment, system maintenance, and technical support.

RESULTS AND DISCUSSION

Infrastructure development is a basic need in the digital age of education. The major issues related to digital libraries are: creating basic infrastructural facilities, generating awareness among the users, developing repositories to save the historical evidence and preserving cultural heritage. To promote progress towards SDGs and to work towards the NEP 2020 goals in education, the government has taken major initiatives to promote digital and sustainable practices in education. Many online courses, along with online tutoring, discussion boards, and online assessment tools, are available to enhance student performance, supported by infrastructure that lets students and teachers engage on the same platform to improve teaching and learning. The Government has focused on improving the availability and accessibility through different initiatives but there is still a need to do more than that. Most research highlights the need for strong policy intent and for stronger local implementation and empowerment. Digital education is directly connected to Sustainable Development Goal 4(Quality Education). Jain and Khokher (2024), emphasized that sustainable digital education requires coordinated investment in infrastructure, locally relevant digital content, teacher capacity development, and community participation. Providing quality education not only expands access to education,

but also supports long-term access for career and professional development. Online platforms such as SWAYAM and NPTEL offer sustainability-focused courses that are freely accessible and modules are based on environmental and sustainable topics. The SWAYAM portal serves more than 30 million learners nationwide. This is the power of digital platforms to entertain people nationwide and enhance their knowledge and understanding. Njoku et al. (2025) The authors recommended increased investment in broadband infrastructure, public-private partnerships, affordable connectivity, and digital literacy programs to strengthen inclusive development. Digital platforms must promote and provide safety and security for enrolled students. Cybersecurity is one of the important aspects of digital platforms there is a need to pay attention to this to build learners' trust and motivation to enroll in online learning platforms. All the above-discussed benefits of online learning. There are some challenges at the digital infrastructure level such as insufficient electricity, bandwidth, lack of institutional funding and the digital divide in rural areas.

Educational Implication

- The integration of Artificial Intelligence in Education is to promote adaptive learning, identify individual students' needs and provide tailored educational content to students. Investing in digital infrastructure and internet connectivity is needed. Southern and Western India show higher adoption of Artificial Intelligence due to better infrastructure.
- Data privacy and security concerns also challenge access to education. National Education Policy 2020 also promotes secure digital platforms and data protection practices. The recording of students' personal information, online assessments and ethical use of AI learning systems are the major concerns given in education policy.
- Government of India is addressing the challenges in digital education and initiating many innovative digital platforms, such as, DIKSHA, NISTHA, Digital India, Bharat Net, and the Digital Personal Data Protection Act, whose aim is to improve digital infrastructure, reduce AI costs, and enhance teacher training through digital platforms.
- PM e-Vidya is a unified platform for promoting digital education. It unifies all efforts including TV channels, online platforms and radio. It is basically based on the slogan 'One Nation One Digital Education'. To collaborate with schools and educational institutions to provide benefits to learners in enhancing their knowledge and experiences.

CONCLUSION

Digital infrastructure serves as a fundamental prerequisite for equitable and effective digital education. India, a geographically diverse and populous country, digital connectivity across rural and urban regions is essential to facilitating students' access to digital resources and providing equitable opportunities. In the current scenario the use of digital education has made a mark in every field. To compete at the global level there is a need to increase the focus on the availability and accessibility of digital platforms. Most of the educational institutions need to encourage digital education. Significant challenges remain in achieving universal and inclusive digital access. The government should shift its attention towards rural and remote areas that they get accessibility of internet connectivity and reliable electricity access. To reduce the digital divide there is still a need to take influential initiatives. Digital education in India supports a 21st-century, skill-based education system. There are different gaps in terms of infrastructure, teacher training and quality content. The NEP 2020 policy envisions that technology is a peripheral tool and a core component of our education system.

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