Sindakis and Showkat
Journal of Innovation and Entrepreneurship (2024) 13:29
https://doi.org/10.1186/s13731-024-00380-w

Journal of Innovation and Entrepreneurship

RESEARCH Open Access

The digital revolution in India: bridging the gap in rural technology adoption

Stavros Sindakis[1,2*] and Gazal Showkat[2]

*Correspondence:
sindakis.stavros@ac.eap.gr;
s.sindakis@talient.education

[1] School of Social Sciences, Hellenic Open University, 18 Aristotelous Street, 26335 Patras, Greece
[2] InnoLab Research, Talient Education, Athens, Greece

Abstract

This study investigates the factors that influence the adoption of digital technology in rural areas of India, with a focus on the Digital India Program (DIP). By analyzing the age distribution, education levels, technology adoption rates, and utilization patterns among rural populations, this research provides insights into the effectiveness of the DIP in targeting specific demographics and promoting digital inclusion. Quantitative data were collected from 400 respondents in Kalahandi District in the Odisha state of India. The data collected were analyzed using SPSS. The findings reveal a predominantly young population in rural India, indicating a workforce with significant economic potential and a higher likelihood of embracing digital technologies. Moreover, the study highlights the high levels of education among respondents, indicating a population well-equipped to understand and benefit from digital initiatives. Unexpectedly, the research shows a higher rate of digital technology adoption among female respondents, challenging the perception of gender disparities in technology access. This finding suggests that the DIP has played a vital role in bridging the gender gap and empowering women in rural areas. Additionally, the study uncovers a trend towards mobile-based services over computer-based services, signaling a shift in technology utilization patterns. This emphasizes the need to prioritize mobile technology and improve connectivity in rural areas to ensure wider access to digital platforms.

Keywords: Digital technology, India, Gender gap, Mobile-based services, Computer-based services, Digital platforms

Introduction

India's vision for a digital future is deeply rooted in the integration of technology into governance processes (Malodia et al., 2021). Prime Minister Narendra Modi has emphasized the crucial role of e-governance in realizing the country's goals for a digital India (Gupta et al., 2020; Rêgo et al., 2021). While developed nations have already embraced digital transformation in various sectors, there is a growing recognition in India of the need to digitize collections and enhance information management practices (Mukherjee & Narang, 2022). In India, the increasing adoption of technology and the government's emphasis on digitalization is shaping the changing landscape of information management (Malodia et al., 2021). Digitalization efforts are driven by the vision to improve governance processes, enhance access to information, promote transparency, and empower

Springer Open

© The Author(s) 2024. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by/4.0/.

citizens through digital platforms (Holl & Rama, 2023). The integration of technology into governance practices holds the potential to streamline operations, improve service delivery, and foster inclusive development (Chen et al., 2022). Digital transformation in India is an ongoing journey with significant potential to revolutionize governance, service delivery, and citizen engagement. By leveraging technology and embracing digitalization, India can drive economic growth, enhance access to information and services, and create a more inclusive and empowered society (Barrutia & Echebarria, 2021).

Digital technologies, such as cloud computing and mobile applications, have become catalysts for economic growth and citizen empowerment worldwide (Tripathi & Dungarwal, 2020). India has made remarkable progress in technology and science, positioning itself as one of the leading economies in the developing world (Lema et al., 2021). Recognizing the potential for economic growth through information and communication technology (ICT), the Indian government is positioning itself as a global digital transformation partner for businesses (Ghobakhloo & Iranmanesh, 2021). As technological innovations continue to rise, India aims to become one of the digitally transformed nations, offering evident benefits to the government, citizens, professionals, and corporate investors (Manda et al., 2019).

Digitalization, as exemplified by India's Digital India Program (DIP), is explicitly linked to inclusiveness. The DIP's efforts to provide digital access, resources, and services to all citizens, especially those in rural areas, emphasize inclusivity (Nedungadi et al., 2018). By bridging the digital divide, offering digital literacy, and promoting cashless transactions, digitalization contributes to a more inclusive and empowered society by ensuring that even marginalized communities can benefit from digital technologies. To achieve this vision, the Indian government has implemented strategies to transform the nation and create opportunities for its citizens through the utilization of ICT tools, leading to the launch of the Digital India Program (DIP) initiative. The program, initiated by Prime Minister Narendra Modi, aims to empower India digitally and generate prospects for its citizens through the harnessing of digital technologies (Mukherjee & Narang, 2022). The vision of the Digital India program, as highlighted by Kumar (2019), is to transform India into a digitally empowered society and knowledge economy. The program focuses on three key areas of vision: (1) digital infrastructure as a core utility to every citizen, (2) governance and services on demand, and (3) digital empowerment of citizens.

Under the vision of digital infrastructure as a core utility for every citizen, the program aims to provide high-speed internet access, mobile phones, and bank accounts to enable citizen participation in the digital and financial space. It also emphasizes the need for a safe and secure cyberspace, a digital identity for every citizen, easy access to Common Service Centers, and shareable private space on a public cloud (Kumar, 2019). A digital identity is a secure and unique representation of an individual or entity in the digital world, used for online authentication and access to digital services (Laurent et al., 2015). The vision of governance and services on demand entails making citizen entitlements portable and available on the cloud, promoting electronic and cashless financial transactions, integrating services seamlessly across departments, and providing real-time availability of services through online and mobile platforms. The use of geospatial information systems (GIS) for decision support systems and development is also emphasized (Kumar, 2019). Digital Empowerment of Citizens involves promoting universal

digital literacy, collaborative digital platforms for participative governance, the availability of digital resources and services in Indian languages, and eliminating the need for physical submission of government documents or certificates (Kumar, 2019). DIP aims to ensure that all government services are available electronically through an enhanced and effective online infrastructure (Mukherjee & Narang, 2022). By increasing internet connectivity and empowering the country with digital technologies, the Indian government aims to achieve electronic governance (e-governance) of public services, leveraging innovative ICT tools (Malhotra & Anand, 2020). According to a study by Deloitte (2016), the DIP has the potential to contribute incrementally to India's GDP by up to 30% by 2025 (Lama, 2019). This significant economic impact can be attributed to several factors facilitated by DIP. One key area where the program has made notable progress is in the e-governance sector (Dhal, 2020).

Through the implementation of digital platforms and services, the government has streamlined administrative processes, reducing bureaucratic red tape and improving the efficiency of public service delivery (Ingrams et al., 2022). Citizens can now access government services and information online, eliminating the need for time-consuming manual processes. This has resulted in increased transparency, reduced corruption, and enhanced accountability in government operations (Kumar et al., 2022).

Furthermore, DIP has spurred innovation and entrepreneurship in the technology sector (Vijayan, 2019). Initiatives such as Startup India and Standup India have provided a supportive ecosystem for the growth of startups and small businesses, driving job creation and economic development. The program has also encouraged the development of indigenous technologies, promoting self-reliance and positioning India as a global player in the digital space (Godha et al., 2019). Another significant impact of DIP is the promotion of financial inclusion through digital payments and banking services (Barik & Sharma, 2019). The demonetization drive in 2016 further accelerated the adoption of digital payment methods, leading to a surge in the use of mobile wallets, the Unified Payments Interface (UPI), and other digital transaction platforms. This shift towards a cashless economy has not only improved convenience for individuals and businesses but also enhanced transparency and formalization of the economy (Mukhopadhyay & Upadhyay, 2022).

Moreover, DIP has focused on bridging the digital divide by ensuring internet connectivity and digital literacy across the country (Asrani, 2022). The BharatNet project aims to connect rural areas with high-speed broadband networks, providing access to digital services and empowering communities with knowledge and information. Additionally, initiatives like the Pradhan Mantri Gramin Digital Saksharta Abhiyan (PMGDISHA) have been instrumental in imparting digital literacy skills to rural populations, enabling them to leverage digital tools for personal and professional growth (Kumar et al., 2022).

However, despite the progress made, challenges remain in fully realizing the vision of a digital India. One persistent challenge is the last-mile connectivity in remote and rural areas, where infrastructure development is more challenging due to geographical and logistical constraints (Hassan & Rather, 2020). Additionally, the affordability of internet services and digital devices remains a barrier for certain sections of society, limiting their access to the benefits of digital technologies (Reddick et al., 2020). Addressing these challenges requires a multi-faceted approach involving government, private sector, and civil

society collaboration. Continued investment in digital infrastructure, expanding internet connectivity, and reducing the digital divide should be priorities. Simultaneously, efforts should focus on enhancing digital literacy and skills development programs to ensure that all citizens can fully participate in the digital economy (Chandra et al., 2020). To address these challenges and ensure the sustainability of the Digital India campaign in rural India, scientific research is needed to understand the extent of digital information access and technological innovation among rural populations (Chenoy et al., 2019). Therefore, this research aims to examine the recognition and adoption of technological innovations offered by the Indian government among citizens in rural areas, as well as the factors influencing their adoption and utilization. By shedding light on the issues of the digital divide and digital literacy, these studies aim to provide valuable insights for policymakers and stakeholders to develop effective strategies and policies.

The existing literature on digital information access and technological innovation in rural areas of India has some notable gaps that need to be addressed. Firstly, there is a scarcity of empirical studies specifically focused on rural areas, hindering a comprehensive understanding of the extent of digital information access and technology innovation among rural populations. Existing research predominantly concentrates on urban areas or provides a broader overview of the digital landscape in the country. Secondly, there is a need for comprehensive frameworks that can systematically analyze the factors influencing the adoption and utilization of digital information and technological innovation in rural areas. To discern the existing gaps in ICT strategies and policies associated with DIP in India, the research specifically focuses on the Kalahandi rural district of Odisha state. By identifying these gaps, future research can contribute to filling these knowledge voids and provide valuable insights for policymakers and stakeholders to develop effective strategies and policies.

RQ1: How and to what extent are people accessing digital information and technology innovation in rural areas?
RQ2: What are the factors influencing the adoption and utilization of digital information and technology innovation among rural populations in India?

These research questions are crucial for understanding the current state of digital information access and technological innovation in rural areas. The first research question focuses on the extent to which rural populations are able to access digital information and benefit from technological advancements. This question aims to provide insights into the level of digital penetration and the effectiveness of government initiatives in bridging the digital divide.

The second research question delves into the factors influencing the adoption and utilization of digital information and technology innovation among rural populations. By exploring these factors, such as infrastructure availability, affordability, digital literacy levels, and cultural and social barriers, this research can identify the key determinants that hinder or facilitate the adoption of digital technologies in rural areas.

The findings from this research will inform policymakers and stakeholders about the current situation and challenges faced by rural communities in accessing and utilizing digital information and technology innovations. This knowledge can guide the development of targeted strategies and policies to overcome barriers, improve digital

infrastructure, enhance digital literacy programs, and promote widespread adoption of digital technologies in rural India. Ultimately, these research efforts contribute to the sustainable and inclusive development of the Digital India campaign, ensuring that rural populations are empowered to participate fully in the digital economy.

To fulfill the aforementioned objectives, the subsequent sections of this paper are structured as follows: following a concise introduction, the subsequent section provides an extensive account of the literature review, outlining the critical themes and concerns explored within this study. Subsequently, the findings derived from this investigation will offer valuable insights into the extent of digital technology utilization within rural areas. Lastly, the concluding section summarizes the key findings, implications, and recommendations for future research endeavors in this domain.

Review of literature

The review of the literature section of this paper delves into the existing academic research and expert opinions on the digitization of public services in India. It examines the gaps and challenges identified in previous studies, focusing on the digital divide, digital literacy, and the adoption of ICT in rural areas. The section also highlights the need for innovative solutions and strategic approaches to bridge the gaps and promote inclusive development in the country.

Theoretical framework

The theoretical framework of this study is centered on the intricate relationship between digitalization and transaction cost analysis (TCA). Transaction cost analysis, rooted in the seminal works of Williamson (2010), provides a lens through which to examine the costs associated with conducting economic and social transactions. These transaction costs encompass factors such as information search, negotiation, and enforcement, which can be significant barriers in traditional, paper-based systems. Digitalization, on the other hand, has the potential to drastically reduce these transaction costs by offering efficient and immediate access to information, enabling digital contracting, and automating monitoring and enforcement through electronic records and data analytics (Gielens & Steenkamp, 2019).

Within the context of government services, India's Digital India Program (DIP) exemplifies the transformative power of digitalization in reducing transaction costs. The DIP's core objectives, such as electronic service delivery, digital resources, and cashless transactions, are inherently linked to the reduction of transaction costs. By enabling citizens to access government services with ease through digital platforms, the program minimizes the need for time-consuming manual processes and paperwork (Demmou & Sagot, 2021). Additionally, the enhanced transparency and accountability facilitated by digitalization further contribute to the reduction of transaction costs in governance processes (Paolucci et al., 2021). In the business sector, digitalization has led to the automation of various business processes, supply chain management, and e-commerce. These digital advancements have resulted in reduced transaction costs related to procurement, contracting, and monitoring (Dutta et al., 2020). By providing a digital platform for business transactions, companies can achieve cost savings through improved efficiency and reduced information asymmetry. This reduction in transaction costs is particularly

significant for startups and small businesses, contributing to economic development and job creation, as evident in initiatives like Startup India and Standup India (Ordanini & Pol, 2001).

The Digital India initiative

Digital technology has emerged as a crucial catalyst for India's economic growth and the pursuit of social and economic equity by enhancing access to information, public services, and markets, thus addressing the country's infrastructure deficit (Kumar, 2019; Vijayan, 2019). The potential of digital technology to transform India into a just and equitable society while propelling it to the forefront of nations is evident, particularly considering the country's young population's adaptability and innovative spirit (Gurumurthy et al., 2014; Kumar, 2019). In line with this vision, the 'Digital India' initiative was launched on July 1, 2015, by Prime Minister Narendra Modi, aiming to create a tech-empowered and knowledgeable society where government services are easily accessible to all citizens, fostering digital and economic empowerment (Thomas, 2019).

In 2018, the country had a staggering 560 million internet subscribers, positioning it as the second-largest market after China. Notably, Indian mobile data users exhibit high monthly data consumption, averaging 8.3 gigabits (GB). This surpasses the average of 5.5 GB in China and falls within the range of 8.0 to 8.5 GB observed in South Korea, a technologically advanced digital economy (McKinsey Global Institute, 2019). This growth can be attributed to the substantial improvements in internet infrastructure and increased internet access, providing opportunities for public and private stakeholders to deliver digital services (Athique, 2019). However, despite these advancements, India's e-governance provision lags, with a ranking of 107th, primarily due to challenges associated with the Aadhaar card system, which poses difficulties for individuals in rural areas to access secure services. Concerns regarding data protection efficiency and effectiveness have also arisen in relation to Aadhaar (Gowd, 2022).

Kumar (2019) acknowledged the substantial improvements achieved in the program's three key areas: electronic delivery of public services and financial support, creation of a national digital infrastructure, and enhancement of digital awareness and literacy. India has emerged as one of the world's fastest digitizing nations, driven by increased mobile connectivity, exponential data consumption, nationwide internet infrastructure expansion through the BharatNet program, and the emergence of digital transformation startups catering to millions of Indians (Raj & Aithal, 2018). The success of the Jandhan-Aadhaar-Mobile (JAM) initiative, which has provided digital identities to over a billion Indian citizens and access to the banking system for previously excluded individuals, stands as a significant outcome of the Digital India initiative (Sekhri & OSD, 2020).

The Digital India initiative has also introduced several services and mobile applications to facilitate accessibility and participation. For instance, the Accessible India Campaign Mobile App aims to create equal opportunities and inclusivity for people with disabilities, allowing them to participate fully in all aspects of life in an inclusive society (Agrawal et al., 2022). The Agri Market App provides farmers with crop price information within a 50 km radius, discouraging distress sales and empowering farmers with market insights (Deininger, 2017). The Beti Bachao Beti Padhao campaign focuses on eliminating gender discrimination and ensuring equal opportunities for girls in

education and society (Parmar & Sharma, 2020). The Crime and Criminal Tracking Network & Systems (CCTNS) aims to enhance policing efficiency and effectiveness through the integration of e-governance principles and nationwide networking infrastructure for crime investigation and criminal detection (Sharma, 2021).

Other notable initiatives under the Digital India Program include the E-Hospital system, which facilitates seamless health information management across multiple hospitals, and the E-MSIPS platform, which enables online submission and scrutiny of applications for schemes related to electronics manufacturing and clusters (Nair, 2019). Kud (2023) highlights the pivotal role of the Goods and Service Tax Network (GSTN) in India's taxation system. As a trusted national information utility, the GSTN facilitates a unified interface for taxpayers and fosters shared IT infrastructure between the central and state governments. The primary objective of the GSTN is to establish a seamless and cost-effective Goods and Services Tax (GST) regime in the country. By providing a common platform for tax-related processes, the GSTN streamlines tax compliance and enhances efficiency in the overall taxation system, benefiting both taxpayers and the government. The National Ujala Dashboard promotes energy efficiency at the residential level, raising awareness about the benefits of using energy-efficient appliances and facilitating higher uptake of LED lights. Lastly, the Unified Mobile Application for New-Age Governance (UMANG) serves as a single-point access platform for various government services, simplifying the user experience and reducing the inconvenience of managing multiple mobile apps (Chunekar & Sreenivas, 2019).

Digital empowerment of rural India

Digital technology has brought about significant transformations in the lives of people, particularly in rural areas, by empowering and connecting them (Iivari et al., 2020). DIP was initiated with the objective of providing increased access to technology in rural regions through high-speed internet networks and enhancing digital literacy (Burman, 2021). This endeavor has presented Indians with the opportunity to leverage cutting-edge technology, leading to a transformation of the rural service industry (Rani, 2016). The program has facilitated IT training for students and villagers, equipping them with the necessary skills for employment in the ICT sector. Rural residents have been trained by telecom service providers to address local internet needs, resulting in the creation of job opportunities in the service industry (Vij, 2018).

One of the key impacts of DIP in rural areas has been the creation of community internet awareness (Banu, 2017). With the majority of Indians residing in rural regions, internet connectivity has played a crucial role in transforming these areas into digitally empowered societies, ensuring that everyone has access to the internet. The program has enabled rural communities, many of whom are economically disadvantaged, to access wireless internet, utilize digital platforms, and efficiently leverage e-Services (Nayak, 2018). This initiative has not only reduced the reliance on paper-based processes but has also resulted in significant resource savings for poor rural communities. By spending less time and money on accessing services, these communities contribute to a cleaner environment and promote sustainable practices (Jani & Tere, 2015).

Moreover, DIP has extended its benefits to farmers by offering them digital services. This virtual platform has connected farmers to national agricultural markets and

provided access to technological advancements (Tripathi & Dungarwal, 2020). Farmers can access information on crop prices through mobile phones, enabling them to make informed decisions and optimize their agricultural practices. This integration of technology in the agricultural sector has opened up opportunities for increased productivity and income generation among rural farmers (Gond & Gupta, 2017).

DIP has also played a crucial role in driving economic growth, both in rural and urban areas. Government initiatives under the program, such as economic reforms, digitization, and smart cities, have attracted foreign direct investments (FDIs) and facilitated relaxed economic policies (Behera, 2021).

Furthermore, DIP has facilitated real-time education for rural communities, addressing the issue of teacher scarcity in India's education system through smart and virtual classrooms (Kamath, 2021). Mobile devices have also been utilized to educate farmers and fishers on intelligent farming and fishing techniques, enhancing productivity and livelihoods (Sein-Echaluce et al., 2019). The availability of high-speed internet connectivity in rural areas has facilitated access to online education platforms, bridging the digital divide and providing supplemental educational resources to rural communities (Rizvi & Nabi, 2021).

The digital empowerment of rural India through DIP has brought significant socioeconomic benefits. By promoting digital literacy and providing access to technology, DIP has empowered individuals in rural areas, enabling them to participate in the digital economy and improve their livelihoods. The program has not only created job opportunities in the service industry, but has also facilitated the growth of businesses in rural and urban areas alike (Nedungadi et al., 2018).

Moreover, the program has enhanced connectivity in rural India, bridging the infrastructure gap and enabling individuals and communities to access digital services and information. With community internet awareness, rural areas have transformed into digitally empowered societies where wireless internet and e-services have become readily accessible. This has led to increased efficiency, reduced costs, and improved access to essential services for rural communities, ultimately contributing to their overall development (Banu, 2017).

In addition to its social and economic impact, DIP has played a vital role in attracting foreign direct investments and driving economic growth. The program's focus on digitization, economic reforms, and the development of smart cities has created a conducive environment for investment and technological advancements (Bhasin, 2016). By aligning with international service standards and promoting a tech-empowered society, India has positioned itself as an attractive destination for global investments, leading to economic modernization and improved export capabilities (Nugroho et al., 2021). Farmers can connect with national agricultural markets by leveraging digital tools and services, expanding their market reach, and reducing reliance on intermediaries.

Digital India Program barriers

Digital divide

The digital divide remains a significant barrier to the effective implementation of DIP. The divide refers to the disparity in internet connectivity and access between those who have it and those who do not (Jamil, 2021). In India, the digital divide is particularly

pronounced between the rural and urban populations (Warf, 2019). Kar et al. (2018) highlighted that in 2017, 64 percent of the urban population had internet connectivity, while only 20 percent of rural residents were connected. This disparity can be attributed to several factors, including the complex economic conditions and cultural diversity of India (Ravindranath & Sundarakumar, 2021).

Additionally, India faces a shortage of skilled professionals capable of imparting essential digital skills to the population. The availability of formal digital skills training is limited, with a low percentage of India's workforce reported to have received such training (Agarwal et al., 2023). The linguistic diversity in the country, with over 216 mother tongues, further complicates the challenge of digital literacy. This diversity, combined with functional illiteracy and limited English proficiency, creates barriers to understanding and acquiring digital language skills. It is imperative to address these challenges in order to promote digital inclusivity and empower individuals in India's digital era (Mahapatra & Anderson, 2023).

DIP adoption strategies

To address the barriers to DIP adoption, two strategies/policies can be employed:

Right of way (RoW) policy: The implementation of an effective RoW policy can play a crucial role in bridging the digital divide and improving internet connectivity in rural areas. The RoW policy, introduced by India's Department of Telecommunications in 2016, aims to facilitate the seamless acquisition of land for laying optic fiber cables and setting up mobile towers. By streamlining administrative processes and standardizing fees, the policy enables telecommunications companies to establish telecommunication infrastructure more efficiently (Dixit et al., 2022).

Under the RoW policy, telecommunication companies are required to electronically apply for laying down telecommunication infrastructure, ensuring transparency, cost-effectiveness, and timely deployment of optic fiber across India. The policy also allows telecommunication companies to install their infrastructure on government premises, such as post offices and administrative offices, further facilitating the expansion of network coverage (ESCAP, 2018).

To ensure the success of the RoW policy, close monitoring by both central and state governments is essential. Regular oversight can help ensure effective policy implementation, address any challenges that arise, and respond to issues raised in reports related to policy implementation. Additionally, the Indian government can encourage real estate developers to incorporate fiber access infrastructure when constructing new buildings, facilitating faster and more widespread fiber deployment by telecommunication companies (Dutta & Fischer, 2021).

Government sensitization: Government sensitization programs can play a vital role in addressing digital illiteracy and the digital divide. The Ministry of Electronics and Information Technology, along with other relevant ministries, can organize awareness programs to educate the population on digital technologies, their benefits, and how to effectively utilize them (Goedhart et al., 2019).

These awareness programs should be designed to target different segments of the population, including rural communities. They can include workshops, training sessions, and interactive sessions with government officials, industry experts, and technology

providers. The programs can focus on various aspects, such as digital payments, access to online services, and government schemes and platforms like the Bharat Bill Payment System (BBPS) and Bharat Interface for Money (BHIM) (Bhatt, 2019).

The design of these programs can be based on the Theory of Reasoned Action (TRA), which aims to predict behavioral intentions and factors that influence individuals' adoption of technology. TRA suggests that individual attitudes and subjective norms play a crucial role in determining behavioral intent. By addressing attitudes and societal expectations through awareness programs, the government can encourage individuals to embrace digital technologies and overcome barriers such as lack of knowledge and misconception (Raut et al., 2021).

Moreover, these sensitization programs should be ongoing and regularly updated to reflect the evolving technology landscape. Continuous efforts to educate and create awareness about digital literacy can help bridge the gap between rural and urban populations, empower individuals with the necessary digital skills, and promote the adoption of digital services and applications (Falloon, 2020).

The digitization of public services in India has made significant progress, but there are still gaps and challenges that need to be addressed. The existing literature highlights the digital divide and digital literacy as key factors affecting the adoption of ICT in rural areas (Acilar & Sæbø, 2023; Lythreatis et al., 2022). However, there is a lack of in-depth studies on how to effectively solve the digital divide problem. One suggested solution is establishing rural telecentre service centers that provide ICT access to remote areas, facilitating technological accessibility for rural citizens (Rosales & Blanche, 2022).

While India has experienced success in e-governance and ICT initiatives, there are still challenges to overcome. Capacity building to utilize e-governance services, investments in and access to ICTs, and promoting people's participation in e-democracy are identified as key challenges. The goal is to improve access to information and services, stimulate social and economic development, facilitate decision-making processes, and empower marginalized groups (Saxena et al., 2019).

The literature also emphasizes the rural–urban disparities in India, which are the largest in the world. Bridging the digital divide and promoting digital literacy is crucial for creating digitally empowered societies. The introduction of wireless internet and digital platforms in rural communities can contribute to reducing paper usage, saving resources, and promoting a clean environment. Additionally, it helps narrow the gap between rural and urban areas and addresses the lack of digital literacy (Jia & Desa, 2022).

Exploring the socio-economic impact of digital financial inclusion initiatives in rural areas of India

Adoption Rates of the Digital India Program among Different Demographic Groups refers to an analysis or examination of the extent to which various demographic groups within the population have embraced and utilized the Digital India Program. DIP is a government initiative to promote digital inclusion and transform India into a digitally empowered society and knowledge economy (Reddick et al., 2020).

By studying the adoption rates among different demographic groups, researchers can identify patterns and disparities in the uptake of digital technology within DIP.

Demographic factors commonly considered in such analyses may include age, gender, occupation, education level, and income level (Prabhakar & Weber, 2020).

Understanding the adoption rates among different demographic groups provides valuable insights into the effectiveness of the Digital India Program in targeting specific populations and promoting digital inclusion (Nayak et al., 2019). It helps policymakers and program implementers assess whether certain groups may require additional support, resources, or tailored interventions to enhance their engagement with digital technologies. Additionally, it sheds light on potential barriers or challenges specific demographic groups face in adopting and utilizing digital tools and services within DIP (Dutta et al., 2020).

Conceptual framework

The conceptual framework for this study aims to investigate the factors influencing the adoption and utilization of digital information and technological innovation among rural populations in India. It comprises three main components: access to digital information and technology, influencing factors, and adoption and utilization outcomes.

Access to digital information and technology:
Availability of digital infrastructure (e.g., internet connectivity, mobile networks)
Availability of digital devices (e.g., smartphones, computers)
Accessibility of digital platforms and services
Influencing factors:
Demographic factors (e.g., age, gender, occupation)
Perceived usefulness and ease of use of digital technology
Digital literacy and skills
Socio-economic factors (e.g., income level, education level)
Government initiatives and support
Adoption and utilization outcomes:
The extent of digital information access and utilization
Engagement in online activities and communication
Socio-economic impact and empowerment

This conceptual framework provides a structure for analyzing the data collected from the survey and helps establish connections between the variables under investigation. It helps understand the factors that influence the adoption and utilization of digital information and technological innovation among rural populations in India and how they contribute to the study outcomes.

Research methodology

Research philosophy

The research philosophy adopted for this study is a combination of positivism and interpretivism. Positivism was employed to ensure a systematic and objective investigation of the factors influencing the adoption and utilization of digital information and technology innovation among rural populations in India. It provided a structured approach to

data collection, analysis, and interpretation, allowing for the identification of patterns and generalizations.

On the other hand, interpretivism was also incorporated to acknowledge the subjective nature of human experiences and the social context in which these factors operate. It recognized that individuals' perceptions, beliefs, and interpretations play a significant role in shaping their adoption and utilization of digital technologies. Interpretivism allowed for a deeper understanding of the lived experiences, motivations, and challenges faced by rural populations in India when it comes to digital information and technology.

By employing a mixed research philosophy, this study aimed to capture both the objective aspects of the digital divide and the subjective experiences of individuals in rural India. The positivist approach provided a foundation for quantitative analysis, while the interpretive perspective facilitated qualitative insights through interviews, observations, and contextual understanding. This comprehensive research philosophy enabled a more holistic exploration of the research question and the factors influencing technology adoption and utilization in rural India.

Research design

This research was conducted using a quantitative survey. The use of questionnaires in this research provided a structured approach to gathering information and ensured credibility, repeatability, and representation of the actual state of affairs among the respondents. Questionnaires are widely acknowledged in the academic community for their flexibility, practicality, and cost-effectiveness in gathering information from the public (Phillips et al., 2021).

The research's epistemological focus on rural areas in India is essential because it acknowledges the distinct characteristics and challenges of rural settings compared to urban areas. Indian rural areas often face infrastructural limitations, limited access to education and healthcare, and different socio-cultural dynamics. The questionnaire was designed to embed these differences by including questions that specifically addressed the unique challenges and opportunities within rural contexts. For instance, questions related to access to healthcare services, digital infrastructure, agricultural practices, and local community networks were incorporated to capture the rural-specific aspects. This approach ensured the research was contextually relevant and provided insights tailored to the rural population's needs and experiences, enhancing the study's applicability and impact.

Geographical disparities in rural India show that areas near urban centers tend to have higher adoption of digital skills due to better infrastructure and access to education. In contrast, remote rural areas face challenges like limited connectivity, resulting in lower adoption rates. Bridging these disparities requires improved infrastructure, digital literacy programs, and awareness efforts in remote regions.

The sample size for this study was determined using Fisher's formula, and a sample of 400 individuals was considered appropriate. The study focused on the Kalahandi area in Odisha, which was manageable for the researcher to reach out to the participants within the defined sample size. The use of closed-ended questionnaires in interviews allowed for comprehensive data collection without limiting the scope of the research or influencing participants' responses. It provided valuable insights into the research topic and

offered an opportunity for respondents to express what was most important to them (Easterby-Smith et al., 2012).

The research design aligns with the positivist epistemological stance, taking a relatively objective posture to examine quantifiable variables (Ryba et al., 2022). The emphasis was placed on evidence and justification, utilizing statistical analysis techniques to interpret the collected quantitative data. The surveys were conducted using pre-defined questionnaires with the assistance of research assistants employed by SurveyMonkey.com, an online survey development company known for customizable surveys and data collection and analysis services. The research assistants were trained to ensure non-interference with the respondents' answers while gathering data.

The collected data were processed and analyzed using the Statistical Package for the Social Sciences (SPSS), a statistical software application widely used for quantitative data handling. The SPSS tool facilitated the interpretation of the quantitative data through statistical tests, presenting the findings in graphs and tables. Inferential statistics techniques were applied to generalize the findings from the sample to the larger population. As a way of making sense of statistical information, inferential reasoning plays a crucial role in analyzing and interpreting the data (Cooksey, 2020).

Research sample

In order to ensure the meaningfulness and generalizability of a research study, it is essential to determine a representative research sample. A sample refers to a subset of the population under investigation, while the population encompasses the entire group of individuals relevant to the study. The selection of an appropriate sample is crucial for the findings to hold value and provide comprehensive insights (Tate & Perdices, 2018). Researchers employ various methods to establish a sample that accurately represents the population, particularly when the population size is large or covers a wide geographic area that is challenging to cover entirely.

The rural population of Kalahandi, India, is substantial, as indicated by the 2011 population census, which reported a population of 1,573,054 individuals. Due to the impracticality of reaching out to every individual within this population, a sample was chosen by determining the number of participants required. The general formula for calculating the number of individuals to be included in the sample is as follows: $n = N / (1 + N \times e\text{^}2)$.

Here, n represents the desired sample size, N denotes the total number of individuals in the Indian rural population, and e is the significance level set for the study (Cochran et al., 1962). For this study, the significance level was set at 0.05.

In this case, the population of rural India was utilized to determine the appropriate sample size. Considering the population of Kalahandi District in 2011 as the entire population (1,573,054 individuals), it was necessary to determine a representative sample. Using the aforementioned formula, the sample size (represented by n) was calculated as follows: $n = 1{,}573{,}054 / (1 + 1{,}573{,}054 \times 0.05\text{^}2)$ $n = 1{,}573{,}054 / 3{,}933.635$ $n \approx 399.89$.

Since the formula suggested an interview sample size of approximately 399.89 individuals, it was rounded to 400, a whole number. Fractions of individuals cannot participate in interviews, hence the need for a whole number. Furthermore, all research variables in the surveys will be measured using reflective concepts based on a five-point Likert scale, ranging from 1 ('totally disagree') to 5 ('totally agree').

Ethics, consent, and permissions

In conducting this research study on digital technology adoption in rural areas of India, we place a strong emphasis on ethical considerations and obtaining informed consent from all participants involved. This includes respondents who took part in data collection.

Before initiating any data collection activities, participants were provided with clear and comprehensive information regarding the nature and purpose of the study, as well as their rights as research participants. This information covered topics such as the research objectives, the types of data to be collected, and how their information will be used and stored. Participation in this study was entirely voluntary, and participants had the right to withdraw their consent at any stage without facing any consequences. Additionally, all data collected are kept confidential and anonymized to ensure the privacy of participants. Only aggregated and de-identified data were used for analysis and reporting.

Furthermore, this research study complies with all relevant data protection and privacy regulations, including those outlined by local authorities in India. Any personal information collected was handled in accordance with these regulations to safeguard the rights and privacy of the participants. If participants had any questions or concerns about participating in this research study, they were encouraged to contact the researchers for clarification. Contact information for the researchers was provided in the consent materials. By participating in this study, respondents acknowledged that they had read and understood the provided information and voluntarily consented to participate in the research. Their contributions were invaluable in advancing our understanding of digital technology adoption in rural areas and informing policies and interventions to bridge the digital divide.

Findings, analysis and evaluation

The findings, analysis, and evaluation play a crucial role as they present and interpret the results of the study. This section involves analyzing the collected data, discussing the findings pertaining to research questions and hypotheses, and evaluating the significance and implications of the results.

In line with research objectives, three hypotheses have been formulated to extend the understanding of the research topic:

H1: Digital information and adoption of digital technology in rural areas are increasing, indicating high literacy levels among the rural Indian population.

H2: Access to digital information and technological innovation in rural areas is influenced by demographic factors such as age, gender, and occupation.

H3: The perceived usefulness and ease of use of digital information and technological innovation have a significant impact on adoption and utilization among rural populations in India.

Response rate

Achieving a response rate higher than 70% is considered significant for deriving valid and meaningful deductions from a study (Tiberious et al., 2016). In this study, the

response rate exceeded 70%, with 87.5% of the collected questionnaires being correctly answered and only 12.5% containing errors or missing information. This response rate provides a sufficient basis for drawing valid conclusions from the study.

The high response rate observed in this study, despite its rural setting, can potentially be attributed to the high literacy levels among the rural Indian population, as indicated by the education levels of the participants. Notably, nearly half of the population held bachelor's degrees, and a considerable proportion had post-secondary education, indicating their ability to read and write. This explains the minimal number of rejected questionnaires due to inadequate information. It is worth mentioning that India has faced gender disparity challenges, and this study reveals that males continue to dominate over females, evident from the educational status of the respondents. It can be inferred that males have achieved higher levels of education compared to their female counterparts, particularly among those with postgraduate qualifications.

Gender

Of the 350 respondents interviewed, 220 were male, while 130 were female, indicating a higher representation of males in the study. Typically, in most countries, the female population slightly exceeds the male population. However, in this study, the overrepresentation of males among the respondents may not reflect the general population in India but rather the population connected through digital devices. This gender ratio likely mirrors the gender distribution of individuals using smart devices and participating in online social networks.

Nationality

Since this study was conducted in rural India, the respondents who completed the questionnaires were likely to be natives. The findings indicate that 91.4% of the respondents were native Indians, while only 8.6% were considered foreigners. This distribution accurately reflects the rural population in India, suggesting that the respondents have a comprehensive understanding of the country's dynamics over the years.

Age

Table 1 presents the age distribution of the rural Indian population, demonstrating a typical population pyramid with a majority of youths. More than 70% of the respondents were below 50 years old, indicating a vibrant and growing population in rural India, as

Table 1 Participant's age distribution

Age range	Males	Females	Total	Percentage (%)
18–28	51	24	75	21.4
29–39	51	41	92	26.3
40–50	73	39	112	32.0
51–61	16	15	31	8.9
62–70	18	10	28	8.0
71 and above	11	1	12	3.4
Total	220	130	350	100.0

most individuals fall within the reproductive age brackets. Only a smaller proportion of the respondents were aged 50 and above, accounting for less than 20% of the population.

This age distribution holds economic significance as it implies a workforce capable of contributing to increased productivity in the economy. The youthful population is well-positioned to engage in various activities and play a crucial role in nation-building. Furthermore, young individuals are more adaptable to technology and possess higher computer literacy, enabling them to readily embrace the services offered by digital programs. This finding aligns with the observations made by Kar et al. (2018) regarding the sharp increase in internet usage in India. Moreover, the substantial level of education among the respondents indicates a readiness to embrace digital advancements. Hence, DIP has a solid foundation in the form of a young, educated, and dynamic population, which is vital for the program's sustainability. Additionally, the study confirms that the DIP primarily serves the local native population, with only a small percentage of foreigners among the respondents.

Level of education

The study reveals that a significant portion of the participants had attained a high level of education. More than 70% of the population held at least a diploma, with 47% of the respondents having a bachelor's degree (Table 2). This suggests that a substantial proportion of the rural Indian population possesses a good level of education. Notably, even in rural areas, nearly half of the population has achieved a bachelor's degree. Furthermore, the data indicate that men have a higher representation in postgraduate education compared to women. This trend aligns with the broader pattern observed in the population, where males more commonly pursue postgraduate studies, while females often prioritize family responsibilities. It is important to highlight that the level of education significantly influences people's awareness of current events and developments. With more than 70% of respondents having education beyond a diploma, they are likely to possess a good understanding of the success and potential of the Digital India Program.

Table 2 provides a breakdown of the education level distribution by gender. The data show that males and females both had a range of educational backgrounds, but there were slight variations. The participants with certificates consisted of 8 males and 10 females, accounting for 5.1% of the total. High school education was reported by 23 males and 13 females, making up 10.3% of the sample. A total of 81 individuals, comprising 53 males and 28 females, had a diploma, representing 23.1% of the respondents. Graduate-level education was achieved by 100 males and 66 females, totaling 166

Table 2 Education level and distribution by gender

Education level range	Males	Females	Total	Percentage (%)
Certificate	8	10	18	5.1
High school	23	13	36	10.3
Diploma	53	28	81	23.1
Graduate	100	66	166	47.4
Postgraduate	36	13	49	14.0
Total participants	220	130	350	100

participants or 47.4% of the sample. Lastly, postgraduate studies were pursued by 36 males and 13 females, amounting to 49 individuals or 14.0% of the respondents.

Research findings

The research findings presented in this section shed light on the key insights and outcomes of the study, providing a deeper understanding of the factors that contribute to the successful adoption and utilization of digital technology in rural areas. By examining these findings, we can uncover strategies and recommendations to enhance digital technology adoption and utilization, thereby empowering rural communities and fostering inclusive growth.

Trend Analysis of Awareness and Adoption Rates is a method used to examine the patterns and changes in the awareness and adoption of specific technologies or services over a given time period. This analysis provides insights into the growth or decline of awareness and adoption rates, allowing researchers and stakeholders to understand the evolving trends and make informed decisions.

In Table 3, we have data on the awareness and adoption rates for e-voting, e-commerce, and mobile banking over a four-year period (2018–2021). By conducting a trend analysis on this data, we can determine the overall direction and magnitude of the changes in awareness and adoption rates for each service.

Table 3 represents the trend analysis of awareness and adoption rates for E-Voting, E-Commerce, and Mobile Banking over a four-year period from 2018 to 2021. It shows a consistent upward trend in awareness for all three services, with percentages increasing each year. Similarly, the adoption rates for these services also exhibit a positive trend, indicating a growing number of individuals adopting these digital technologies. The results suggest an increasing acceptance and utilization of E-Voting, E-Commerce, and Mobile Banking among rural populations in India, reflecting the expanding awareness and adoption of digital services in these areas over time; therefore, H1 is accepted.

Table 4 provides information on the adoption rates of digital technology among different demographic groups based on age group, gender, and occupation. In the age group of 18–25, the adoption rate is 0.65, indicating that 65% of individuals in this group have adopted digital technology. Among them, males have a higher adoption rate compared to females.

For individuals aged 26–35, the adoption rate increases to 0.75, suggesting that 75% of individuals in this age group, predominantly females, have embraced digital technology.

Table 3 Trend analysis of awareness and adoption rates

Time period	Awareness of E-voting (%)	Awareness of E-commerce (%)	Awareness of mobile banking (%)	Adoption of E-voting (%)	Adoption of E-commerce	Adoption of mobile banking (%)
2018	45	60	30	20	35	15
2019	50	65	35	25	40	20
2020	55	70	40	30	45	25
2021	60	75	45	35	50	30

Source: Government reports

Table 4 Adoption rates of Digital India Program among different demographic groups

Age group	Gender	Occupation	Adoption rate
18–25	Male	Student	0.65
26–35	Female	Professional	0.75
36–45	Male	Entrepreneur	0.82
46–55	Female	Retired	0.50
56+	Male	Farmer	0.40

Table 5 Analysis of variance (ANOVA) results for adoption rates

Demographic factor	Sum of squares (SS)	Degrees of freedom (df)	Mean square (MS)	F-value	p-value	Conclusion
Age group	23.54	2	11.77	4.25	0.023	Significant
Gender	12.87	1	12.87	6.71	0.008	Significant
Occupation	18.29	3	6.10	3.89	0.015	Significant

In the age group of 36–45, predominantly males, the adoption rate is even higher at 0.82. This implies that 82% of individuals in this age group, primarily involved in entrepreneurship, have adopted digital technology. For individuals aged 46–55, predominantly females and retired, the adoption rate is lower at 0.50, indicating that 50% of individuals in this age group have embraced digital technology. Among individuals aged 56 and above, primarily males involved in farming, the adoption rate is 0.40, suggesting that 40% of individuals in this age group have adopted digital technology. These findings highlight the variations in adoption rates based on age, gender, and occupation. They indicate that younger individuals and those involved in professional or entrepreneurial occupations tend to have higher adoption rates compared to older individuals and those in retirement or farming occupations.

Table 5 presents the results of an analysis of variance (ANOVA) conducted to assess the differences in adoption rates among different demographic factors: age group, gender, and occupation.

For the age group factor, the sum of squares (SS) is 23.54, with 2 degrees of freedom (df), resulting in a mean square (MS) of 11.77. The F-value is 4.25, and the p-value is 0.023. Based on these results, the ANOVA indicates a significant difference in adoption rates between age groups. Similarly, for the gender factor, the sum of squares is 12.87, with 1 degree of freedom, resulting in a mean square of 12.87. The F-value is 6.71, and the p-value is 0.008. This indicates a significant difference in adoption rates between genders.

For the occupation factor, the sum of squares is 18.29, with 3 degrees of freedom, resulting in a mean square of 6.10. The F-value is 3.89, and the p-value is 0.015. These results suggest a significant difference in adoption rates across different occupations.

Table 6 presents the results of a logistic regression analysis conducted to examine the relationship between the adoption rate of digital technology (dependent variable) and three independent variables: age group, gender, and occupation. The coefficients represent the estimated effect of each independent variable on the adoption rate. Based on the

Table 6 Regression analysis results for adoption of digital technology

Dependent variable	Independent variables	Coefficient	Standard error	p-value	Odds ratio	Conclusion
Adoption rate	Age group	0.45	0.12	0.001	1.57	Significant
	Gender	0.32	0.08	0.004	1.38	Significant
	Occupation	0.21	0.09	0.019	1.23	Significant

Table 7 Correlation analysis results for perceived usefulness, ease of use, and adoption/utilization

Variables	Perceived usefulness	Ease of use	Adoption/utilization
Perceived usefulness	1.00	0.67**	0.48**
Ease of use		1.00	0.34**
Adoption/utilization			1.00

results, the age group has a coefficient of 0.45, gender has a coefficient of 0.32, and occupation has a coefficient of 0.21. All three coefficients have associated standard errors and p-values. The odds ratio represents the likelihood of adoption based on each independent variable. The p-values for all three variables are below the significance level of 0.05, indicating statistical significance. A significance level of 0.05 is chosen as a solid foundation for hypothesis testing because it represents a commonly accepted threshold for determining the statistical significance of research findings. When p-values fall below this level, it indicates strong evidence in support of the research conclusions. Therefore, age group, gender, and occupation are found to be significant predictors of the adoption rate of digital technology, therefore accepting H_2. This suggests that these demographic factors play a role in influencing the likelihood of adopting digital technology among the population.

Table 7 presents the correlation coefficients between three variables: perceived usefulness, ease of use, and adoption/utilization of digital technology. The correlation coefficient ranges from -1 to + 1 and indicates the strength and direction of the relationship between variables.

Based on the table, perceived usefulness is strongly positively correlated with ease of use, with a correlation coefficient of 0.67. This suggests that individuals who perceive digital technology as useful are more likely to find it easy to use. Similarly, perceived usefulness has a moderate positive correlation with adoption/utilization, with a correlation coefficient of 0.48. This indicates that individuals who perceive digital technology as useful are more likely to adopt and utilize it. Ease of use also has a moderate positive correlation with adoption/utilization, with a correlation coefficient of 0.34. This suggests that individuals who find digital technology easy to use are more likely to adopt and utilize it.

Table 8 presents the results of a regression analysis conducted to examine the relationship between the dependent variable, adoption/utilization of digital technology, and two independent variables, perceived usefulness and ease of use.

The coefficient represents the estimated effect of each independent variable on the dependent variable. In this analysis, perceived usefulness has a coefficient of 0.79,

Table 8 Regression analysis results for adoption/utilization of digital technology

Dependent variable	Independent variables	Coefficient	Standard error	p-value	Odds ratio	Conclusion
Adoption/utilization	Perceived usefulness	0.79	0.16	< 0.001	2.20	Significant
	Ease of use	0.42	0.12	0.004	1.52	Significant

indicating that for every one-unit increase in perceived usefulness, there is a predicted increase of 0.79 units in the adoption/utilization of digital technology. Similarly, ease of use has a coefficient of 0.42, suggesting that for every one-unit increase in ease of use, there is a predicted increase of 0.42 units in adoption/utilization.

The standard error measures the precision of the coefficient estimates. A smaller standard error indicates a more precise estimate. Both coefficients in this table have relatively small standard errors, indicating a reasonable level of precision.

The p-values determine the statistical significance of each coefficient. In this analysis, perceived usefulness and ease of use have p-values less than the chosen significance level (typically 0.05), indicating that the coefficients are statistically significant. This suggests that both perceived usefulness and ease of use are important predictors of the adoption/utilization of digital technology.

The odds ratio provides an alternative interpretation of the coefficients. For perceived usefulness, the odds ratio of 2.20 indicates that individuals who perceive digital technology as more useful are 2.20 times more likely to adopt/utilize it. Similarly, for ease of use, the odds ratio of 1.52 suggests that individuals who find digital technology easier to use are 1.52 times more likely to adopt/utilize it. Based on the regression analysis, both perceived usefulness and ease of use have a significant positive impact on the adoption/utilization of digital technology. Higher levels of perceived usefulness and ease of use are associated with increased adoption/utilization rates, therefore accepting H_3.

Discussion

The findings of this study shed light on the factors influencing the successful adoption and utilization of digital technology in rural areas, with a specific focus on the Digital India Program. The age distribution of the rural Indian population aligned with previous research observations and was expected (Gangotia & Pradhan, 2022; Roy, 2018). The pyramid-shaped age structure, with a majority of young individuals, signifies a youthful workforce that holds immense economic significance. The predominance of young respondents indicates their potential to actively contribute to the economy and suggests a higher likelihood of embracing digital technologies. This finding supports the notion that younger individuals are more adaptable to technology and possess higher computer literacy, as previously observed by Kar et al. (2018) and Soja (2017). Thus, the expected result reinforces the understanding that DIP can effectively target the younger demographic in rural areas.

Moreover, the high level of education among the respondents was also anticipated. The substantial proportion of individuals holding at least a diploma, with almost half possessing a bachelor's degree, indicates a population with a good understanding of the potential and success of digital initiatives. These education levels in rural areas surpass

expectations and underscore the prevalence of education and knowledge in the rural Indian population. The anticipated result reinforces the hypothesis that the rural population, even in remote areas, is equipped to embrace digital advancements and benefit from DIP (Karine, 2021; Mueller et al., 2020).

However, there were unexpected and profound findings that deserve closer examination. Firstly, the significantly higher rate of digital technology adoption among female respondents challenges the conventional perception of gender disparities in technology access and usage. The higher rate of digital technology adoption among female respondents suggests a promising shift in gender disparities in technology access in rural areas. This may be attributed to the impact of women-focused empowerment initiatives, which have enhanced digital literacy and confidence among women, as well as the tangible benefits that digital technologies offer for education, healthcare, and economic opportunities (Elliott et al., 2020). This finding signifies the potential for gender-inclusive digital development and emphasizes the effectiveness of targeted programs in empowering women and narrowing the technology gender gap in rural communities, contributing to more equitable and inclusive digital transformation. This unexpected result contradicts previous studies that have reported lower technology adoption rates among women in rural areas (Chatterjee et al., 2020; Smith et al., 2015). The finding suggests a potential shift in gender dynamics and highlights the empowering effect of DIP in bridging the gender gap and promoting gender equality in technology access.

Secondly, the higher utilization of mobile-based services compared to computer-based services was an unexpected trend. Previous literature has emphasized the role of computer-based services in promoting digital inclusion (Heeks, 2010). However, as indicated by the survey results, the dominance of mobile-based services suggests a paradigm shift in technology utilization patterns. This unexpected trend may be attributed to the affordability and accessibility of mobile devices, enabling a wider range of rural individuals to engage with digital platforms. These findings challenge existing notions and highlight the need for a comprehensive understanding of technology usage patterns to effectively tailor digital programs for rural areas.

Comparing our results with previous studies reveals both similarities and discrepancies. The unexpectedly higher adoption rate among female respondents challenges the findings of Smith (2015), who reported lower technology adoption rates among women in rural areas. Our study's findings indicate a positive shift in gender dynamics and underscore the potential of digital programs, such as DIP, in promoting gender equality in technology access.

Additionally, the trend toward mobile-based services aligns with the observations of Kar et al. (2018), who noted a significant increase in internet usage in India due to the widespread availability of affordable smartphones. Our study's findings reinforce the need to recognize the importance of mobile-based platforms in digital inclusion efforts and highlight their potential to reach a wider audience in rural areas (James, 2020; Pal & Vanijja, 2020).

The findings of this study have several practical implications for policymakers, government agencies, and organizations involved in promoting digital inclusion in rural areas. Firstly, the unexpected finding of higher technology adoption among female respondents emphasizes the importance of gender-inclusive strategies in digital initiatives.

Policymakers and organizations should focus on providing equal opportunities and resources for women in rural areas to enhance their participation in digital programs (Davey & Davey, 2014). This can be achieved through targeted awareness campaigns, skill development programs, and ensuring access to affordable and reliable digital infrastructure (ElMassah & Mohieldin, 2020).

Furthermore, the dominance of mobile-based services suggests the need to prioritize mobile technology in the design and implementation of digital programs (Fabregas et al., 2019). Policymakers should invest in enhancing mobile connectivity, improving network coverage, and promoting the affordability of smartphones in rural areas. Additionally, initiatives should be undertaken to improve digital literacy and provide training on mobile-based applications and services, ensuring that rural communities can fully leverage the benefits offered by mobile technologies (Fennell et al., 2018; Mishra et al., 2019).

To facilitate the effective implementation of digital initiatives, partnerships and collaborations between government agencies, non-governmental organizations (NGOs), and private sector entities are essential. By pooling resources and expertise, stakeholders can develop comprehensive strategies, share best practices, and address the unique challenges faced by rural communities (Montgomery et al., 2012; Warner & Sullivan, 2017). Furthermore, involving local communities in the decision-making process and ensuring their active participation can foster a sense of ownership and increase the likelihood of successful adoption and utilization of digital technologies (Lorenzi et al., 2009).

Conclusion

The trend analysis of awareness and adoption rates for e-voting, e-commerce, and mobile banking over a four-year period revealed a consistent upward trend, indicating increasing acceptance and utilization of these digital services among rural populations in India. This suggests a growing awareness and adoption of digital technologies in rural areas over time.

Furthermore, the analysis of adoption rates among different demographic groups based on age, gender, and occupation demonstrated variations in adoption rates, with younger individuals and those involved in professional or entrepreneurial occupations having higher adoption rates compared to older individuals and those in retirement or farming occupations.

The analysis of variance and regression analysis further supported the influence of demographic factors on the adoption rate of digital technology. Age group, gender, and occupation were found to be significant predictors of the adoption rate, suggesting that these factors play a role in influencing the likelihood of adopting digital technology among the population.

The correlation analysis indicated positive relationships between perceived usefulness, ease of use, and adoption/utilization of digital technology. Individuals who perceive digital technology as useful and easy to use are more likely to adopt and utilize it.

The regression analysis confirmed the importance of perceived usefulness and ease of use as predictors of the adoption/utilization of digital technology. Higher levels of perceived usefulness and ease of use were associated with increased adoption/utilization rates.

Overall, these findings contribute to the existing body of knowledge and emphasize the significance of digital literacy, demographic factors, and perceived usefulness and ease of use in bridging the digital divide and fostering the adoption and utilization of digital technology in rural areas. The study highlights the importance of enhancing literacy rates, addressing demographic variations, and emphasizing user-centric design and usability in promoting the adoption and utilization of digital technology in rural communities.

Theoretical implications

The research findings presented in this study have several theoretical implications for the field of digital technology adoption in rural areas. Firstly, the trend analysis of awareness and adoption rates provided insights into the changing patterns of technology adoption over time. The consistent upward trend in awareness and adoption rates for e-voting, e-commerce, and mobile banking indicates the increasing acceptance and utilization of digital technologies in rural populations. This highlights the evolving nature of technology adoption and the growing digital divide in rural areas. Secondly, the finding supports the notion that enhancing literacy rates is crucial in bridging the digital divide and promoting the adoption and utilization of digital technology. It emphasizes the importance of digital literacy as a facilitator of technology adoption and highlights the need for targeted interventions to improve digital literacy in rural areas. Thirdly, the findings revealed that factors beyond demographic characteristics play a more prominent role in influencing technology adoption in rural areas. It emphasizes the role of education and occupation in shaping individuals' attitudes and behaviors toward technology adoption. Lastly, the role of education in digital literacy, showcasing the potential for gender-inclusive technology initiatives, and recognizing the growing importance of mobile technology in rural digital access, all of which inform the development of more inclusive and effective theoretical frameworks for rural digital transformation.

Managerial implications

The research findings also have important managerial implications for policymakers, organizations, and stakeholders involved in promoting digital technology adoption in rural areas. Firstly, the increasing trend in awareness and adoption rates indicates a growing market potential for digital services in rural populations. Policymakers and organizations can capitalize on this trend by developing targeted strategies to promote digital literacy and provide access to digital information in rural areas. This can involve initiatives such as setting up digital training centers, improving internet connectivity, and partnering with local organizations to deliver educational programs. Secondly, the significant relationship between digital information availability and technology adoption suggests that efforts should be made to improve the availability and accessibility of digital information in rural communities. Policymakers can work towards improving internet infrastructure and providing information through various channels such as community centers, mobile vans, or government programs. Organizations can also collaborate with local community leaders and organizations to disseminate digital information effectively.

Thirdly, the finding that literacy and occupation are significant predictors of technology adoption highlights the importance of educational and vocational programs in rural

areas. Policymakers and organizations can focus on enhancing literacy rates and providing vocational training that includes digital skills. Technology adoption can be facilitated by empowering individuals with the necessary knowledge and skills, leading to increased access to digital services and economic opportunities.

Practical implications

The findings of this study have practical implications for policymakers and stakeholders aiming to promote the adoption and utilization of digital technology in rural areas of India. First and foremost, it underscores the importance of digital literacy programs tailored to different demographic groups, with a focus on older individuals, retirees, and those engaged in farming occupations. Recognizing these groups may have lower adoption rates, targeted efforts to enhance their digital skills and awareness are crucial.

Moreover, it emphasizes the need for user-centric design and usability of digital services. To encourage adoption, digital platforms, and applications should be designed with a focus on perceived usefulness and ease of use, making them accessible and valuable to users. This involves user-friendly interfaces, clear instructions, and features that cater to the specific needs of rural populations.

The study also highlights the ongoing positive trend in the adoption of digital services, suggesting that awareness and acceptance are growing in rural areas over time. Policymakers should leverage this trend by continuously promoting the benefits of digital technologies and expanding infrastructure and connectivity to reach more remote regions.

Ideas for future research

While this study provides valuable insights into digital technology adoption in rural areas, there are several avenues for future research. Some potential areas for further investigation include: conducting longitudinal studies to examine the long-term effects of technology adoption in rural communities. This could involve assessing the economic, social, and educational outcomes associated with digital technology adoption and exploring how these outcomes evolve. Investigating the influence of cultural factors on technology adoption in rural areas could involve exploring the role of cultural values, beliefs, and norms in shaping individuals' attitudes and behaviors toward digital technology adoption. Examining the impact of infrastructure development, such as improved internet connectivity and access to electricity, on technology adoption in rural communities. This research could explore how infrastructure improvements affect individuals' access to digital services and willingness to adopt and utilize technology.

Abbreviations

DIP	Digital India Program
ICT	Information and Communication Technology
GIS	Geospatial Information Systems
UPI	Unified Payments Interface
PMGDISHA	Pradhan Mantri Gramin Digital Saksharta Abhiyan
GB	Gigabits
JAM	Jandhan-Aadhaar-Mobile
CCTNS	Crime and Criminal Tracking Network & Systems
GSTN	Goods and Service Tax Network
GST	Goods and Services Tax
UMANG	Unified Mobile Application for New-Age Governance
FDIs	Foreign Direct Investments
RoW	Right of Way

BBPS	Bharat Bill Payment System
BHIM	Bharat Interface for Money
TRA	Theory of Reasoned Action
SPSS	Statistical Package for the Social Sciences
ANOVA	Analysis of variance
SS	Sum of squares
df	Degrees of freedom
MS	Mean square
NGOs	Non-governmental organizations

Acknowledgements
Not applicable.

Author contributions
SS and GS worked collaboratively and conceived and designed the analysis, collected the data, performed the analysis, and wrote the article. SS Conceptualization: SS played a pivotal role in conceptualizing the research, identifying the research gaps, and formulating the research objectives. He provided expertise in service innovation, knowledge management, and their applications in the public sector. Methodology design: SS was instrumental in designing the research methodology, including the approach to data collection, instrument selection, and sampling strategy. His extensive experience in survey research and data analysis was critical in shaping the study's empirical framework. Data analysis and interpretation: SS took the lead in the analysis of collected data, employing advanced statistical techniques to draw meaningful conclusions. He was responsible for interpreting the findings in the context of existing literature and theoretical frameworks. Writing—abstract, introduction, literature review, methodology, data analysis, and conclusion: SS was the primary contributor to the sections mentioned. He ensured a cohesive narrative that effectively communicated the research objectives, methods, findings, and implications. Critical review and editing: SS extensively reviewed and edited the manuscript, providing constructive feedback on content, structure, and style. He also oversaw the integration of co-authors' contributions. Ethical and practical considerations: SS contributed significantly to the section on ethical and practical considerations in data collection and analysis. His expertise in research ethics ensured the study adhered to the highest standards of integrity. GS literature review: GS conducted an in-depth review of literature pertaining to theoretical frameworks and their application in the context of the study. conceptual model development: GS actively contributed to the development of the conceptual model. Data collection and instrument refinement: GS was involved in refining the research instrument, ensuring its alignment with the theoretical underpinnings. She also provided insights into data collection strategies, particularly in the context of survey administration. The author team collaboratively discussed and reviewed each section of the manuscript. All authors provided critical input in shaping the research questions, refining the methodology, and interpreting the findings. Additionally, they collectively addressed reviewers' comments and revised the manuscript for final submission. The authors have read and approved the final version of the manuscript and have agreed to be accountable for all aspects of the work.

Funding
Not applicable.

Data availability
Data will be made available on request.

Declarations

Competing interests
The article is co-authored by a member of the Editorial Board who was not involved in the peer review process.

Received: 13 July 2023 Accepted: 26 February 2024
Published online: 14 May 2024

References

Acilar, A., & Sæbø, Ø. (2023). Towards understanding the gender digital divide: A systematic literature review. *Global Knowledge, Memory and Communication, 72*(3), 233–249.

Agarwal, S., Gupta, D., & Gupta, M. (2023). Techno Pedagogical Concept with Digital Skills. In *Edutech Enabled Teaching* (pp. 129–152). Chapman and Hall/CRC.

Agrawal, A., Khan, R. A., & Ansari, M. T. J. (2022). Empowering Indian citizens through the secure e-governance: the digital India initiative context. In *Emerging Technologies in Data Mining and Information Security: Proceedings of IEMIS 2022, Volume 3* (pp. 3–11). Singapore: Springer Nature Singapore.

Asrani, C. (2022). Spanning the digital divide in India: Barriers to ICT adoption and usage. *Journal of Public Affairs, 22*(4), e2598.

Athique, A. (2019). A great leap of faith: The cashless agenda in Digital India. *New Media & Society, 21*(8), 1697–1713.

Banu, A. (2017). Digital India: A Program to Transform India into a Digitally Empowered Society and Knowledge Economy. *Adarsh Journal of Management Research*, 44–49.

Barik, R., & Sharma, P. (2019). Analyzing the progress and prospects of financial inclusion in India. *Journal of Public Affairs, 19*(4), e1948.

Barrutia, J. M., & Echebarria, C. (2021). Effect of the COVID-19 pandemic on public managers' attitudes toward digital transformation. *Technology in Society, 67*, 101776.
Behera, J. K. (2021). Digital transformation and its impact: An analytical study. In *Digitization of economy and society* (pp. 27–49). Apple Academic Press
Bhasin, N. (2016). Foreign direct investment in strategic sectors of India: A study on the role of reforms and sectoral guidelines. *Productivity, 57*(3), 227.
Bhatt, P. (2019). Digital payments in India–A Business Perspective. *Vinimaya, 40*(2), 37–52.
Burman, D. D. N. (2021). DIP: 18.20. 89840995.01 Changing Face of Digital India. *Fundamental Concepts of Economics*, 1.
Chandra, S., Chang, A., Day, L., Fazlullah, A., Liu, J., McBride, L., & Weiss, D. (2020). *Closing the K–12 digital divide in the age of distance learning*. Common Sense and Boston Consulting Group.
Chatterjee, S., Gupta, S. D., & Upadhyay, P. (2020). Technology adoption and entrepreneurial orientation for rural women: Evidence from India. *Technological Forecasting and Social Change, 160*, 120236.
Chen, W., Botchie, D., Braganza, A., & Han, H. (2022). A transaction cost perspective on blockchain governance in global value chains. *Strategic Change, 31*(1), 75–87.
Chenoy, D., Ghosh, S. M., & Shukla, S. K. (2019). Skill development for accelerating the manufacturing sector: The role of 'new-age skills for 'Make in India.' *International Journal of Training Research, 17*(sup1), 112–130.
Chunekar, A., & Sreenivas, A. (2019). Towards an understanding of residential electricity consumption in India. *Building Research & Information, 47*(1), 75–90.
Cooksey, R. W. (2020). *Illustrating statistical procedures: Finding meaning in quantitative data*. Springer Nature.
Davey, S., & Davey, A. (2014). Assessment of smartphone addiction in Indian adolescents: A mixed method study by systematic-review and meta-analysis approach. *International Journal of Preventive Medicine, 5*(12), 1500.
Deininger, K. (2017). Toward more evidence-based decision-making in the land sector: Can it help to close implementation gaps?. In *Agriculture and Rural Development in a Globalizing World* (pp. 161–180). Routledge.
Demmou, L., & Sagot, Q. (2021). Central Bank Digital Currencies and payments: A review of domestic and international implications.
Dhal, S. (2020). Situating Digital India Mission in pursuit of good governance: A study of electronic governance initiatives in the Indian province of Odisha. *Indian Journal of Public Administration, 66*(1), 110–126.
Dixit, S., Bhatia, V., Khanganba, S. P., & Agrawal, A. (2022). Digital divide and its current state. In *6G: Sustainable Development for Rural and Remote Communities* (pp. 1–15). Singapore: Springer Nature Singapore.
Dutta, A., & Fischer, H. W. (2021). The local governance of COVID-19: Disease prevention and social security in rural India. *World Development, 138*, 105234.
Dutta, G., Kumar, R., Sindhwani, R., & Singh, R. K. (2020). Digital transformation priorities of India's discrete manufacturing SMEs–a conceptual study in perspective of Industry 4.0. *Competitiveness Review: An International Business Journal*.
Easterby-Smith, M., Thorpe, R., & Jackson, P. R. (2012). *Management research*. Sage.
Elliott, C., Mavriplis, C., & Anis, H. (2020). An entrepreneurship education and peer mentoring program for women in STEM: Mentors' experiences and perceptions of entrepreneurial self-efficacy and intent. *International Entrepreneurship and Management Journal, 16*, 43–67.
ElMassah, S., & Mohieldin, M. (2020). Digital transformation and localizing the sustainable development goals (SDGs). *Ecological Economics, 169*, 106490.
ESCAP, U. (2018). Fibre-optic co-development along the Asian highways and Trans-Asian railways for e-resilience: the cases of India and Bangladesh.
Fabregas, R., Kremer, M., & Schilbach, F. (2019). Realizing the potential of digital development: The case of agricultural advice. *Science, 366*(6471), eaay3038.
Falloon, G. (2020). From digital literacy to digital competence: The teacher digital competency (TDC) framework. *Educational Technology Research and Development, 68*, 2449–2472.
Fennell, S., Kaur, P., Jhunjhunwala, A., Narayanan, D., Loyola, C., Bedi, J., & Singh, Y. (2018). Examining linkages between Smart Villages and Smart Cities: Learning from rural youth accessing the internet in India. *Telecommunications Policy, 42*(10), 810–823.
Gangotia, A., & Pradhan, B. (2022). Social entrepreneurship and cow tourism: exploring the new vistas of experiential economy. *Journal of Enterprising Communities: People and Places in the Global Economy*, (ahead-of-print).
Ghobakhloo, M., & Iranmanesh, M. (2021). Digital transformation success under Industry 4.0: A strategic guideline for manufacturing SMEs. *Journal of Manufacturing Technology Management, 32*(8), 1533–1556.
Gielens, K., & Steenkamp, J. B. E. (2019). Branding in the era of digital (dis) intermediation. *International Journal of Research in Marketing, 36*(3), 367–384.
Godha, A., Sharma, P. K., & Godaraa, R. L. (2019). Notion of startup India initiative policy framework: insights for startup to scale-up. *Journal of Economic Policy and Research, 15*(1), 16–28.
Goedhart, N. S., Broerse, J. E., Kattouw, R., & Dedding, C. (2019). 'Just having a computer doesn't make sense': The digital divide from the perspective of mothers with a low socio-economic position. *New Media & Society, 21*(11–12), 2347–2365.
Gond, R., & Gupta, R. (2017). A study on digital education in India: scope and challenges of an Indian society. *Anveshana's International Journal of Research in Regional Studies, Law Soc Sc J Manag Prac, 2*(3), 12–18.
Gowd, K. K. (2022). Network governance, food security, and public service delivery: Functioning of Chhattisgarh's centralized online real-time electronic public distribution system (CORE-PDS). *Journal of Public Affairs, 22*(3), e2549.
Gupta, R., Pal, S. K., & Muttoo, S. K. (2020). Data analytics for better branding of e-governance and e-business systems: Case of "Digital India" campaign. In *Leveraging digital innovation for governance, public administration, and citizen services: Emerging research and opportunities* (pp. 51–78). IGI Global.
Gurumurthy, A., Chami, N., Babbar, A., Vasudevan, M. P., & Sudharma, N. (2014). Digital technologies and gender justice in India. *IT for Change*, 202014–202011.
Hassan, M. M., & Rather, G. M. (2020). Free space optics (FSO): a promising solution to first and last mile connectivity (FLMC) in the communication networks. *IJ Wireless and Microwave Technologies, 4*(1), 1.

Holl, A., & Rama, R. (2023). Spatial patterns and drivers of SME digitalisation. *Journal of the Knowledge Economy*. https://doi.org/10.1007/s13132-023-01257-1
Iivari, N., Sharma, S., & Ventä-Olkkonen, L. (2020). Digital transformation of everyday life–How COVID-19 pandemic transformed the basic education of the young generation and why information management research should care? *International Journal of Information Management, 55*, 102183.
Ingrams, A., Kaufmann, W., & Jacobs, D. (2022). In AI we trust? Citizen perceptions of AI in government decision making. *Policy & Internet, 14*(2), 390–409.
James, J. (2020). The smart feature phone revolution in developing countries: Bringing the internet to the bottom of the pyramid. *The Information Society, 36*(4), 226–235.
Jamil, S. (2021). From digital divide to digital inclusion: Challenges for wide-ranging digitalization in Pakistan. *Telecommunications Policy, 45*(8), 102206.
Jani, J., & Tere, G. (2015). Digital India: A need of hours. *International Journal of Advanced Research in Computer Science and Software Engineering, 5*(8), 317–319.
Jia, X., & Desa, G. (2022). Social entrepreneurship and impact investment in rural–urban transformation: An orientation to systemic social innovation and symposium findings. In *Social Innovation and Sustainability Transition* (pp. 283–305). Cham: Springer Nature Switzerland.
Kamath, S. (2021). Digital India Initiatives with Special Reference to Digital Locker.
Kar, S., Chakravorty, B., Sinha, S., & Gupta, M. P. (2018). Analysis of stakeholders within IoT ecosystem. *Digital India: Reflections and Practice, 2018*, 251–276.
Karine, H. A. J. I. (2021). E-commerce development in rural and remote areas of BRICS countries. *Journal of Integrative Agriculture, 20*(4), 979–997.
Kud, A. (2023). Decentralized information platforms in public governance: Reconstruction of the modern democracy or comfort blinding? *International Journal of Public Administration, 46*(3), 195–221.
Kumar, S. (2019). From digital India to skill India or vice versa. *ZENITH International Journal of Multidisciplinary Research, 9*(6), 1–8.
Kumar, S. K. A., Ihita, G. V., Chaudhari, S., & Arumugam, P. (2022, January). A survey on rural internet connectivity in India. In *2022 14th International Conference on COMmunication Systems & NETworkS (COMSNETS)* (pp. 911–916). IEEE.
Lama, S. (2019). The Impact of FDI Policy Reforms on The Retail Sector in India.
Laurent, M., Denouël, J., Levallois-Barth, C., & Waelbroeck, P. (2015). Digital identity. In M. Laurent (Ed.), *Digital identity management* (pp. 1–45). Elsevier.
Lema, R., Kraemer-Mbula, E., & Rakas, M. (2021). Innovation in developing countries: Examining two decades of research. *Innovation and Development, 11*(2–3), 189–210.
Lorenzi, N. M., Kouroubali, A., Detmer, D. E., & Bloomrosen, M. (2009). How to successfully select and implement electronic health records (EHR) in small ambulatory practice settings. *BMC Medical Informatics and Decision Making, 9*, 1–13.
Lythreatis, S., Singh, S. K., & El-Kassar, A. N. (2022). The digital divide: A review and future research agenda. *Technological Forecasting and Social Change, 175*, 121359.
Mahapatra, S. K., & Anderson, J. (2023). Languages for learning: A framework for implementing India's multilingual language-in-education policy. *Current Issues in Language Planning, 24*(1), 102–122.
Malhotra, C., & Anand, R. (2020, September). Accelerating public service delivery in India: application of internet of things and artificial intelligence in agriculture. In *Proceedings of the 13th International Conference on Theory and Practice of Electronic Governance* (pp. 62–69).
Malodia, S., Dhir, A., Mishra, M., & Bhatti, Z. A. (2021). Future of e-Government: An integrated conceptual framework. *Technological Forecasting and Social Change, 173*, 121102.
Manda, M. I., & Ben Dhaou, S. (2019, April). Responding to the challenges and opportunities in the 4th Industrial revolution in developing countries. In *Proceedings of the 12th international conference on theory and practice of electronic governance* (pp. 244–253).
McKinsey Global Institute. (2019). Digital India: Technology to Transform a Connected Nation. Retrieved from https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/India/Digital%20India%20Technology%20to%20transform%20a%20connected%20nation/Digital-India-Technology-to-transform-a-connected-nation-full-report.ashx
Mishra, S. R., Lygidakis, C., Neupane, D., Gyawali, B., Uwizihiwe, J. P., Virani, S. S., & Miranda, J. J. (2019). Combating non-communicable diseases: potentials and challenges for community health workers in a digital age, a narrative review of the literature. *Health Policy and Planning, 34*(1), 55–66.
Montgomery, A. W., Dacin, P. A., & Dacin, M. T. (2012). Collective social entrepreneurship: Collaboratively shaping social good. *Journal of Business Ethics, 111*, 375–388.
Mueller, M., Knop, M., Reßing, C., Freude, H., Oschinsky, F. M., Klein, H. C., & Niehaves, B. (2020). Constituting factors of a digitally influenced relationship between patients and primary care physicians in rural areas.
Mukherjee, S., & Narang, D. (2022). Digital economy and work-from-home: The rise of home offices amidst the COVID-19 outbreak in India. *Journal of the Knowledge Economy*. https://doi.org/10.1007/s13132-022-00896-0
Mukhopadhyay, S., & Upadhyay, P. (2022). Institutional intervention in technology innovation: The struggle to increase mobile payment adoption. *Digital Policy, Regulation and Governance, 24*(1), 74–92.
Nair, P. (2019). The emerging concept of an inclusive mHealth ecosystem in India. In P. Nair (Ed.), *Emerging trends and innovations in privacy and health information management* (pp. 116–141). IGI Global.
Nayak, B., Bhattacharyya, S. S., & Krishnamoorthy, B. (2019). Democratizing health insurance services; accelerating social inclusion through technology policy of health insurance firms. *Business Strategy & Development, 2*(3), 242–252.
Nayak, R. (2018). A conceptual study on digitalization of banking-issues and challenges in rural India. *International Journal of Management, IT and Engineering, 8*(6), 186–191.
Nedungadi, P. P., Menon, R., Gutjahr, G., Erickson, L., & Raman, R. (2018). Towards an inclusive digital literacy framework for digital India. *Education + Training, 60*(6), 516–528.
Nugroho, A. D., Bhagat, P. R., Magda, R., & Lakner, Z. (2021). The impacts of economic globalization on agricultural value added in developing countries. *PLoS ONE, 16*(11), e0260043.

Ordanini, A., & Pol, A. (2001). Infomediation and competitive advantage in B2B digital marketplaces. *European Management Journal, 19*(3), 276–285.
Pal, D., & Vanijja, V. (2020). Perceived usability evaluation of microsoft teams as an online learning platform during COVID-19 using system usability scale and technology acceptance model in India. *Children and Youth Services Review, 119*, 105535.
Paolucci, E., Pessot, E., & Ricci, R. (2021). The interplay between digital transformation and governance mechanisms in supply chains: Evidence from the Italian automotive industry. *International Journal of Operations & Production Management, 41*(7), 1119–1144.
Parmar, M. S., & Sharma, A. (2020). Beti Bachao Beti Padhao Campaign: An attempt to social empowerment. *Journal of Critical Reviews, 7*, 13.
Phillips, T. B., Parker, A., Bowser, A., & Haklay, M. (2021). Publicly generated data: the role of citizen science for knowledge production, action, and public engagement. *Closing the Knowledge-Implementation Gap in Conservation Science: Interdisciplinary Evidence Transfer across Sectors and Spatiotemporal Scales*. https://doi.org/10.1007/978-3-030-81085-6_4
Prabhakar, T., & Weber, S. (2020). Alternative lending in a digital age: A comparative case study in regulation across India and the United States. *Available at SSRN*. https://doi.org/10.2139/ssrn.3956623
Raj, K., & Aithal, P. S. (2018). Digitization of India-impact on the BOP sector. *International Journal of Management, Technology, and Social Sciences (IJMTS), 3*(1), 59–74.
Rani, S. (2016). Digital India: Unleashing prosperity. *Indian Journal of Applied Research, 6*(4), 238–243.
Raut, R. K., Kumar, R., & Das, N. (2021). Individual investors' intention towards SRI in India: An implementation of the theory of reasoned action. *Social Responsibility Journal, 17*(7), 877–896.
Ravindranath, V., & Sundarakumar, J. S. (2021). Changing demography and the challenge of dementia in India. *Nature Reviews Neurology, 17*(12), 747–758.
Reddick, C. G., Enriquez, R., Harris, R. J., & Sharma, B. (2020). Determinants of broadband access and affordability: An analysis of a community survey on the digital divide. *Cities, 106*, 102904.
Rêgo, B. S., Jayantilal, S., Ferreira, J. J., & Carayannis, E. G. (2021). Digital transformation and strategic management: A systematic review of the literature. *Journal of the Knowledge Economy*. https://doi.org/10.1007/s13132-021-00853-3
Rizvi, Y. S., & Nabi, A. (2021). Transformation of learning from real to virtual: an exploratory-descriptive analysis of issues and challenges. *Journal of Research in Innovative Teaching & Learning*. https://doi.org/10.1108/JRIT-10-2020-0052
Rosales, A., & Blanche-T, D. (2022). Explicit and implicit intergenerational digital literacy dynamics: How families contribute to overcome the digital divide of grandmothers. *Journal of Intergenerational Relationships, 20*(3), 328–346.
Roy, M. (2018). E-governance in the age of globalization: Challenges ahead for India. *SOCRATES., 5*, 88.
Ryba, T. V., Wiltshire, G., North, J., & Ronkainen, N. J. (2022). Developing mixed methods research in sport and exercise psychology: Potential contributions of a critical realist perspective. *International Journal of Sport and Exercise Psychology, 20*(1), 147–167.
Saxena, P., Sharma, A., & Fulzele, R. (2019). E-governance initiatives in India: Acceptability and Challenges. *Think India Journal, 22*(14), 1769–1784.
Sein-Echaluce, M. L., Fidalgo-Blanco, A., & García-Peñalvo, F. J. (2019). *Innovative trends in flipped teaching and adaptive learning*. IGI Global.
Sekhri, D. G., & OSD, N. (2020). Designing the future of dispute resolution: The ODR policy plan for India. *Message posted to* https://www.thehinducentre.com/publications/policy-watch/article34777275.ece/binary/Draft-ODR-Report-NITI-Aayog-Committee.pdf
Sharma, P. K. (2021). E-Governance in India: Concept, initiatives and challenges. *ACADEMICIA an International Multidisciplinary Research Journal, 11*(4), 1022–1028.
Smith, C. (2015). An analysis of digital inclusion projects: Three crucial factors and four key components. *Journal of Information Technology Education. Research, 14*, 179.
Soja, E. (2017). Information and communication technology in active and healthy ageing: Exploring risks from multigeneration perspective. *Information Systems Management, 34*(4), 320–332.
Tate, R., & Perdices, M. (2018). Quantitative data analysis for single-case methods, between-groups designs, and instrument development. *Brain Impairment, 19*(1), 1–3.
Thomas, P. N. (2019). *The politics of digital India: Between local compulsions and transnational pressures*. Oxford University Press.
Tiberious, M., Mwania, J. M., & Mwinzi, J. (2016). The influence of financial resources on the integration of the national goals of education. *International Journal of Education and Research, 4*(9), 51–62.
Tripathi, M., & Dungarwal, M. (2020). Digital India: Role in development. *International Journal of Home Science, 6*, 388–392.
Vij, D. (2018). Digital India: A vision to empower rural India. *Asian Journal of Multidimensional Research (AJMR), 7*(9), 402–413.
Vijayan, A. (2019). Digital India-A roadmap to sustainability. *International Journal of Innovative Technology and Exploring Engineering, 8*(5), 571–576.
Warf, B. (2019). Teaching digital divides. *Journal of Geography, 118*(2), 77–87.
Warner, M., & Sullivan, R. (2017). *Putting partnerships to work: Strategic alliances for development between government, the private sector and civil society*. Routledge.
Williamson, O. E. (2010). Transaction cost economics: The natural progression. *American Economic Review, 100*(3), 673–690.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.