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Empowering Nigeria's e-Society: A Comprehensive Exploration of Cutting-Edge Digital Services

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Amidst a transformative landscape marked by increased internet penetration, mobile ownership, and digital literacy, Nigeria faces disparities in access and affordability that must be urgently addressed. This study explores Nigeria's digital evolution trajectory, examining the rapid advancements, challenges, and opportunities in building an empowered e-society. The COVID-19 pandemic necessitated remote interactions, evidencing the adaptability of online work, banking, governance, and education services. Emerging technologies like artificial intelligence, cloud computing, and blockchain also carry immense potential to reshape these realms if underpinned by people-centric design. While growing mobile ownership and dynamic startup ecosystems indicate strong foundations, gaps remain in inequitable access, unaffordable data costs, low rural connectivity, and varying digital capacities across income and gender groups. The study's roadmap analysis suggests that realising ambitious e-governance targets requires extensive public-private collaboration from the needs assessment stage, leveraging Nigerian innovation capabilities. The study concludes that vision statements on Nigerian e-society must translate into implementation plans with phase-wise targets, funding allocations, and citizen-centric metrics for successive upgrades. Sustained political commitment, institutional partnerships, and emphasis on leaving no one behind are crucial to fulfilling digitisation goals and citizen expectations in the coming decade.

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INTRODUCTION

Nigeria has witnessed rapid technological and digital advances in recent years (Atanda et al., 2021). Increased internet penetration, expanding digital infrastructure, and a growing tech-savvy youth population have transformed domains like commerce, governance, banking, education, and healthcare (Portion et al., 2023; Shukla et al., 2023). It has also enabled innovative African technology startups to emerge. As of January 2023, Nigeria's digital environment accounted for 122.5 million internet users and 31.60 million social media users, representing 14.3% of the country's total population, while internet penetration stood at 55.4% (Datareportal, 2023). E-commerce platforms, digital payment systems, and global tech providers have also entered the market to tap into this growth. While the COVID-19 pandemic negatively impacted the economy, it accelerated digital adoption for remote work, online transactions, virtual services, and edtech platforms. These trends indicate a vast scope for e-services to reshape socio-economic development.

Further harnessing technologies like artificial intelligence, big data analytics, the Internet of Things (IoT), and blockchain can enhance the delivery of welfare schemes, increase citizen participation, promote financial inclusion, facilitate transparent governance, and inform data-driven policymaking (Soetan et al., 2021). As digital governance expands through online portals and virtual offices, citizens can digitally access features like license applications, tax payments, passport renewals, and municipal complaints. Such integration can reduce corruption, paperwork, and visitations to government offices (Abdulquadri et al., 2021). However, there exist gaps in equitable access to affordable digital services, capabilities to leverage them, policy priorities, and investments required to expand such services (Ajah & Chigozie-Okwum, 2019). Bridging these can accelerate Nigeria's vision of a robust, empowered digital society.

Realising the Digital Nigeria vision requires recognising obstacles impeding society-wide adoption of e-services and leveraging emerging technologies to suit local contexts cost-effectively (Uzoigwe & Eze, 2018). While Nigeria has achieved substantial progress in areas like internet penetration, startup ecosystems, and online user bases, the equitable transition toward an empowered, knowledge-based digital society remains challenged by systemic gaps in affordable access, capabilities, and public sector digitisation (Yina, 2020). Past studies have assessed technology adoption trends, citizen readiness perceptions, and e-governance maturity in silos. Holistic analysis of infrastructural limitations, emerging solution pathways aligned to priorities, and practical roadmaps bridging stakeholder efforts can significantly advance universal participation goals underlying Nigeria's e-society ambitions.

This study thus aims to identify specific obstacles inhibiting inclusivity, analyse global best practices across policy and technological dimensions for insights, highlight sectoral focus areas and their readiness levels, discuss realistic roadmap elements considering local constraints, and present an actionable framework for coordinated progress between multiple ecosystem stakeholders. Equally, the framework analysis provides vital theoretical lenses for examining the technology-society interplay, while the concluding section summarises key recommendations for the major actors involved. The study contributes updated insights and practical guidelines towards measured digitisation of citizen services to uplift efficiencies, trust, and transparency in Nigeria's digital society progression over the following decades. Findings can guide policy reforms and investments that federal and state agencies need to establish the building blocks of a digitally transformed, citizen-centric Nigeria over the next decade.

Research Aim & Objectives

This study aims to investigate how digital technologies are transforming socio-economic development and governance in Nigeria, and to

identify the opportunities and challenges associated with expanding equitable access to digital services.

Research Objectives

The study's primary objectives are to analyze the role of emerging technologies (e.g., AI, IoT, blockchain) in enhancing public service delivery, education, governance transparency, healthcare, commerce, and financial inclusion, and to examine the current state of digital infrastructure and internet penetration in Nigeria, as well as their impact.

Global Trends in Digital Services

The global adoption of digital technologies and the internet over the past decade has enabled new models of economic growth, governance, commerce, and citizen services (Zhai et al., 2023). Countries such as India, Estonia, South Korea, Singapore, the UAE, and Saudi Arabia have established thriving e-society ecosystems that span cashless payments, virtual education, and e-health records, as well as remote employment systems powered by digital IDs. Their exponential success can inform roadmaps for similarly placed developing countries on key infrastructures, policy reforms, and public-private partnerships needed to expand affordable e-services nationally.

For instance, India's Aadhaar biometric digital ID program has enrolled over 1.2 billion citizens in a common database for streamlining welfare schemes, taxation, bank accounts, and authentication (Sinha, 2023). Such a foundational ID layer has empowered the rapid growth of payment apps, fintech firms, gig workers, online classrooms, and telemedicine across the massive population through appropriate customer identification protocols. Equally, Estonia, Singapore, the UK, and Turkey have all implemented e-governance models to improve citizen-centric services. Estonia's e-governance model allows citizens to access nearly 3000 services online, increasing transparency and saving time (Kniazieva et al., 2023). Singapore's Smart Nation initiative uses AI, big data, and IoT to improve municipal services (Khang et al.,

2023). The UK's Gov.uk provides transactional services, while Turkey's rise in e-gov development highlights the importance of public internet access centres, digitisation, and data infrastructure (Oliychenko et al., 2023).

These case studies showcase the government's vision, investments in digital public infrastructure, including cloud systems and cybersecurity, as well as PPP models for scaling indigenous solutions and change management to address gaps in accessibility, affordability, and digital literacy across urban-rural divides (Beylis et al., 2023). The market-based innovations here have transformed economic participation and last-mile delivery. The lessons for Nigeria constitute integrating localised adaptations of such technologies suiting needs, contexts, and scale, along with policy reforms that incentivise rapid adoption among citizens.

Hence, governmental interventions on affordable internet plans, introductory device provisions, digital skilling programs, and demonstrating value in social benefit payouts, municipal permissions, and institutional access can shape positive usage behaviour (Boateng et al., 2023). Using the above mechanisms, the gradual migration of bureaucratic processes onto e-governance platforms can empower societal adoption. Such strategies uphold the principles of an equitable information society focused on accessibility, inclusiveness, and literacy. The roadmap for an empowered Nigerian e-society, therefore, lies in recognising gaps that inhibit adoption, learning from global best practices on enablers, and formulating localised strategies that factor in infrastructural limitations and socio-cultural dynamics, while conveying the direct value of digital public services through awareness drives to build trust and participation at scale.

Theoretical Framework Guiding Analysis of Technology-Led Societal Transformation and e-Society Models

In the context of analysing technology-led societal transformation and e-society models in Nigeria, several theoretical frameworks play a crucial role. According to Joseph Ng and Eaw (2023), one such

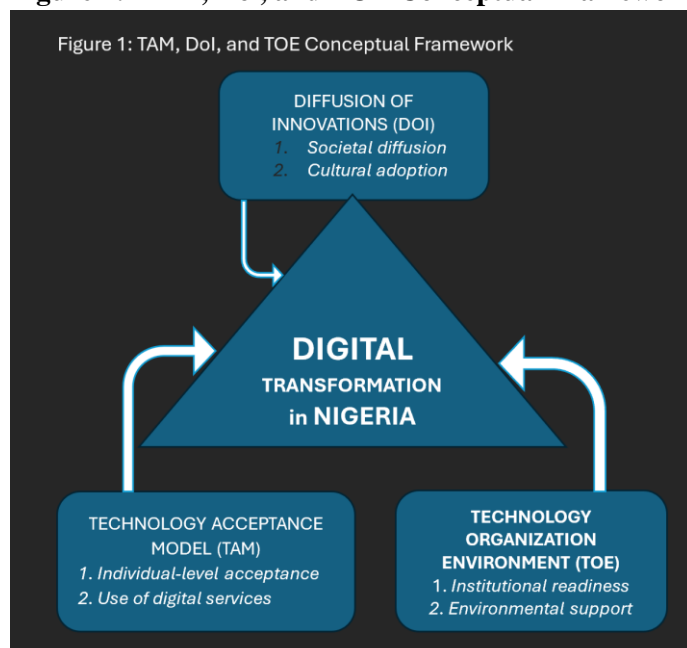
paradigm that focuses on users' acceptance of technology is the Technology Acceptance Model (TAM). For societal change to be successful in Nigeria, it is essential to comprehend how people and communities accept and use technology. TAM posits that perceived ease of use and perceived usefulness influence users' attitudes toward technology adoption (Alhalaybeh & Althunibat, 2023), shedding light on factors that could enhance or impede technological integration in Nigerian society.

The Diffusion of Innovations theory, developed by Everett Rogers, provides another valuable lens for examining technology adoption and transformation (Deryl et al., 2023). This theory emphasises the spread of innovations through a population and identifies different adopter categories, ranging from early adopters to laggards. Analysing Nigeria's e-society models through the Diffusion of Innovations theory provides a comprehensive understanding of how various population segments engage with and adopt technological innovations. This framework helps policymakers and stakeholders tailor strategies to target different adopter categories and facilitate a more widespread acceptance of technology.

The Technology, Organisation, Environment (TOE) framework offers a broader perspective, considering the interplay between technology, organisational factors, and the external environment (Amini & Jahanbakhsh-Javid, 2023). In the Nigerian context, this framework can guide the analysis of how technological advancements align with organisational structures and adapt to the country's unique environmental conditions. The TOE framework recognises that successful technology adoption is not solely dependent on technological factors but also on organisational capabilities and the broader socio-economic context in Nigeria.

When applied collectively, TAM, Diffusion of Innovations, and TOE provide a comprehensive theoretical foundation for analysing Nigeria's technology-led societal transformation and e-society models. By considering individual acceptance factors, diffusion patterns, and the broader organisational and environmental context, researchers and policymakers can gain insights into the complexities of technology adoption in the Nigerian context. This multifaceted approach allows for a nuanced understanding that can inform the development and implementation of effective strategies for leveraging technology to drive societal transformation in Nigeria.

Figure 1: TAM, Dol, and TOE Conceptual Framework



The combination of TAM, DOI, and TOE, in this study, helps construct a comprehensive framework to assess digital transformation in Nigeria across three dimensions:

Individual-level acceptance and use (TAM), Societal diffusion and cultural adoption (DOI), and Institutional readiness and environmental support (TOE).

This theoretical triangulation enhances the research's analytical depth by enabling multi-layered observation, data collection, and interpretation, encompassing a range of perspectives from user perceptions to institutional practices and systemic policy gaps, providing a foundation for further research.

CURRENT STATE OF DIGITAL SERVICES IN NIGERIA

Nigeria has made significant progress in expanding access and usage of digital technologies over the past decade (Ighomereho et al., 2023). Internet penetration has risen from 11% in 2010 to over 63% in 2020, with over 100 million Nigerians online today (Onukwuli et al., 2023). Smartphone adoption is around 50%, with growing ownership of devices supporting digital lifestyles. Key policy thrusts like the National Broadband Plan, National e-Government Strategies, and Digital Literacy Councils have also boosted digitisation.

The universal access funds aim to extend ICT services through subsidies to rural areas left out by private telcos (Neogi, 2023). Phase one connected over 300 communities to voice and data networks at subsidised rates. The second phase targets deploying towers for unserved areas and fibre-optic networks to boost backhaul connectivity. Such programs also address affordability barriers for economically weaker sections regarding the acquisition of internet-enabled devices. On e-Governance, the Ministry of Communications coordinates various projects on digitising identification systems like national ID cards, passports, and vehicle registration processes. States like Lagos, Ogun, Anambra, and Kaduna have implemented citizen-centric portals

for payments of taxes, utilities, and other municipal services (Fahm, 2023). However, most states are still in the early phases of e-governance models with low adoption outside metros. Data protection, privacy, and cybersecurity regulations also require upgrades to build user trust.

Gaps persist between urban and rural areas regarding internet availability, network resilience, and data plans or device costs that are still unaffordable for poorer families (Arakpogun et al., 2023). This affects rural youth's opportunities for remote work, education, and skills. The gender gap also inhibits women's access to digital banking, networking, or voice against harassment (Chiluwa, 2022). Such groups need contextualised support through localised content, vernacular interfaces, and gender-sensitive digital literacy drives. Nigeria, however, enjoys a thriving technology hub ecosystem centred in Yaba, Lagos, that has birthed startups like Paystack, Flutterwave, Andela, and Piggyvest, among others (Ahmed et al., 2023). These demonstrate innovative applications of digital tools in fintech, logistics, recruitment, and commerce sectors for national needs. Their partnerships with universities promote skill development and research on disruptive technologies like artificial intelligence, robotics, and nanotech. Such R&D can accelerate Nigeria's e-services framework.

Therefore, Nigeria's technology infrastructure and internet connectivity have progressed, but suffer from deficits in broadband quality, affordability, and reliability, requiring large-scale investments. More citizens are using tools like mobile apps, social media, and e-commerce platforms, indicating receptiveness to online services. But much scope exists for policies and localised solutions that leave no one behind while transitioning towards a knowledge society centred on efficient, transparent e-governance.

CUTTING-EDGE DIGITAL SERVICES AND TECHNOLOGIES

Emerging technologies like blockchain, artificial intelligence, the Internet of Things, and cloud computing can drive innovative models for

service delivery across governance, banking, agriculture, and healthcare sectors in Nigeria (Awotunde et al., 2021). Blockchain's decentralised, transparent structure has applications across land registries, public distribution systems, elections, and integrated identity management (Maesa & Mori, 2020). Startups have piloted blockchain in supply chain traceability, e-voting, and credential verification use cases. Equally, AI and machine learning can optimise tasks of predicting prison overcrowding, intelligent transport routing, and healthcare diagnoses through learning from multidimensional datasets (Górriz et al., 2020). AI chatbots are assisting in global customer queries, utility complaint redressal, and community engagement by governments. For e-Government platforms, cloud computing provides scalability, security, and storage. Massive data repositories, including case records, automobile registration archives, and tax history, can be combined and digitised for anytime access by moving legacy systems to the cloud.

The Nigerian government has adopted cloud services for domains like treasury transactions, passport tracking, and visa application processing (Attaran & Gunasekaran, 2019). Machine learning algorithms can also comb through this data to uncover insights on process optimisation, usage patterns, and policy impact assessment. Emerging frameworks on data governance, model transparency, and testing AI biases are integral, given the public sector's adoption of advanced algorithms. The Internet of Things ecosystem of networked sensors transmitting data offers real-time, location-based monitoring of public infrastructure like water pipelines, waste bins, highways, and warehouses (Malik et al., 2021). Predictive analytics on the data can foresee troubles -from leakages to grid failures- enabling preventative maintenance. Such ambient intelligence can elevate living standards through effective utility management.

Nigeria boasts a vibrant fintech environment with startups utilising APIs, AI analytics, and blockchain for various payment products catering to Nigeria's largely unbanked population

(Iheanacho & Oluwasemilore, 2021). Mobile and digital payments have enabled financial inclusion, from simpler USSD and SMS-based transactions to complex robo-advisory investment platforms. However, data protection and surveillance regulations are vital amid rising online fraud cases.

While these technologies offer promising opportunities, concerns about automation have led to job losses, inadequate skilling among the workforce for the future, and data theft risks that linger globally. Hence, Nigeria's roadmap must assess societal preparedness for the advanced technology-based transformation of service delivery models while formulating mitigation strategies for vulnerable demographic groups. Emerging technologies harbour immense potential for efficient and transparent e-services, but prudent adoption remains key.

Key Sectors for Prioritising Advanced e-Services in Nigeria

Global case studies on e-society development underscore Governance as the pivot for integrating emerging technologies across service delivery, given the public sector's scale and data repositories. Nigeria's planned Government Enterprise Architecture (GEA) framework envisages consolidating identities, records, processes, and data exchanges between agencies into a connected, cloud-based system (Alenoghena et al., 2022). Citizens can then digitally access entitlements and seamlessly track applications through the governance lifecycle. Equally, Machine learning algorithms can uncover insights from vast data on bottlenecks like utilisation ratios, pendency metrics, and beneficiary satisfaction to improve planning and resource allocation (Nassef et al., 2022). Such AI integration can elevate efficiencies, conveniences, and trust in governing institutions over time. Adopting frameworks like India's open API architecture can also catalyse contextual e-governance innovation by startups.

As digital payments expand financial inclusion, policy thrusts must enhance customer awareness

of safe digital transaction practices and cyber fraud redressal mechanisms (Ranjith et al., 2021). Leveraging India's Unified Payment Interface model can further interlink bank accounts, mobile wallets, and merchant endpoints for seamless fund routing at scale. Compliance technologies are also vital for regulated sectors, given money laundering and terror financing concerns amid rising fintech adoption (Akartuna et al., 2022). Also, Edtech innovation must move beyond video content to reimagine pedagogical formats using virtual reality, machine translation of texts, and gamified assessments for better learning outcomes (Johnson & Salter, 2022). To nurture digital creativity, policy recommendations include computational thinking integration in secondary school curricula and promoting student participation in solving community problems using technologies through national-level challenge competitions.

Robotic surgeries in large hospitals can elevate precision and speed, but access barriers for the majority of the population persist (Jafarzadeh et al., 2022). Hence, medical drones, mobile clinics, and remote screening devices deserve policy thrusts for cost-effectively extending life-saving healthcare to rural areas. Telemedicine platforms have enabled prescriptions and second opinions, but data standards, ethical oversight of AI diagnosis tools, and doctor skilling remain crucial for patient safety as virtual health expands (Haleem et al., 2022). Therefore, envisaging smart Nigerian cities requires enterprise architecture that binds the building blocks of governance services, utility infrastructures, digital identity frameworks, integrated transport networks, and data exchange interfaces. Close public-private collaboration is vital for codifying complex interlinkages, protocols, and regulatory checkpoints to materialise this ambition securely, economically, and efficiently.

ROADMAP FOR EMPOWERING NIGERIA'S E-SOCIETY

Realising Nigeria's digital transformation necessitates a national e-governance plan with a clearly defined vision, policies, implementation

roadmaps, funding allocations, and monitoring metrics. During phase-wise rollouts over the next decade, the plan must articulate priorities across infrastructure boosts, service delivery upgrades, capacity building, and localisation needs (Olanusi, 2020). A federated, rather than siloed, approach toward digitisation calls for structured coordination between central, state, and municipal agencies through digital councils for system integrations and joint digital skilling drives (Febriyanti et al., 2023). Centralised protocols around foundational datasets, interoperability standards, and APIs can assist startup innovation, too. Open data access will spur research on societal problems.

Nigeria possesses strong engineering and entrepreneurial talent pools, which are evident in rising startup ecosystems (Baldin, 2023). Hence, the roadmap must evolve from the ground up by synergising government stewardship with robust private sector participation models during needs analysis, design prototyping, and customisation stages of large modernisation projects. Such collaboration can optimise public digital platforms' risks, resources, and innovations. India's Aadhaar biometric ID system, CoWIN vaccine tracker, and UPI payments interface successfully demonstrate public-private partnership models, open API architecture, and rapid iterative upgrades responding to citizen feedback. Local IT enterprises develop client-specific functions over the core infrastructure managed by government stakeholders. Policy labs provide evidence to improve programs.

The plan must be cognizant of Nigeria's socioeconomic stratifications and tailor support interventions like rural internet connectivity drives, gender inclusion funds, income-based device subsidies, and digital skilling programs for youth. Infrastructure without capabilities is insufficient; hence, budgets for digital literacy campaigns for farmers, informal sectors, and government workforces are vital societal investments. Progress monitoring should assess e-services adoption metrics segmented by location, income, gender, and age, covering aspects like registered subscribers, platform visits,

transactions per account, and customer satisfaction ratings of key initiatives. Surveys localised to major languages can provide citizen input. Such findings can inform timely course corrections in rollout strategies.

OPPORTUNITIES AND CHALLENGES GOING FORWARD

If underpinned by sound infrastructure and policies, Nigeria's digital services ecosystem can accelerate financial inclusion, participative governance, transparent service delivery, startup contextual innovation, and productivity upgrades across economic sectors (Pazarbasioglu et al., 2020). Studies show that 10% higher broadband connectivity fetches 1.38% in GDP growth rates (Adeleye & Eboagu, 2019). Hence, returns on investments toward affordable internet and public data platforms are demonstrable over the long term (Alenoghena et al., 2022). Vision, articulation, and committed leadership are vital to driving large administrative machinery into new modes of functioning. Institutional resistance and entrenched inefficiencies inherited from legacy structures pose reform roadblocks that require both policy incentives and persistent stewardship to overcome. Hence, high-level Digital Councils are needed to harmonise the activities of stakeholders like government bodies, academia, civil societies, and businesses during transformation projects.

Emerging technologies will inevitably render specific jobs and skills obsolete, necessitating mechanisms to support displaced and new workforces through transitional phases of re-skilling, financial security, and employment generation programs (Arakpogun et al., 2022). Concerns around data colonisation, surveillance, and algorithmic biases also deserve mitigation frameworks involving civil society representations. Efforts to nurture local innovation and IP creation are equally important. Nigeria's substantial informal employment base also risks exclusion from formal financial channels and e-services access policy interventions, mainly targeting the organised sector. Last-mile internet connectivity or banking

correspondents' model can assist cash-based, seasonal occupations in gradually migrating toward digital modes of exchange and transactions. Localisation of global digital platforms to native languages and non-smartphones is vital.

Gender-inclusive finance schemes enabling women to pursue digital entrepreneurship can uplift incomes and social equity. Incentives for youth-led technology startups and elderly-sensitive customer service channels also resonate with Nigeria's demography (Awotunde et al., 2021). Thus, the roadmap should be responsive to the needs of diverse citizen groups during the planning and upgrades of digital public services spanning healthcare, pensions, utilities, or regulatory compliance. Therefore, an empowered Nigerian e-society measures progress beyond economic targets through universal access and usage metrics of citizen-centric digital services. Managing trade-offs around emerging technologies requires balancing economic ambitions with the data sovereignty of citizens and preparedness for technological disruptions through partnerships between government, businesses, and academia.

CONCLUSION

In conclusion, Nigeria stands at a critical juncture in its digital evolution, which is marked by rapid technological advancements and transformative shifts in various sectors. The country has experienced substantial growth in internet penetration, mobile phone ownership, and digital literacy, laying the foundation for a thriving digital society. The COVID-19 pandemic further accelerated the adoption of digital services, highlighting the potential for innovative solutions like e-commerce, remote work, and virtual education. However, this digital progress is not without challenges. Disparities in access, affordability, and digital literacy persist, particularly among regions, income groups, and genders. The study underscores the importance of addressing these gaps to ensure an inclusive and equitable transition to an empowered e-society. Exploiting cutting-edge technologies, including

artificial intelligence, blockchain, and the Internet of Things, offers promising avenues for reshaping service delivery, governance, and economic participation.

The roadmap for empowering Nigeria's e-society involves strategic interventions in infrastructure development, digital literacy programs, and robust public-private partnerships. Policies should be crafted to bridge urban-rural divides, promote financial inclusion, and enhance cybersecurity measures. The study emphasises the significance of a federated approach involving collaboration between the government, private sector, and civil society to navigate the complexities of digital transformation successfully.

A holistic and collaborative approach is imperative to propel Nigeria towards an empowered e-society. Policymakers should prioritise the development of robust digital infrastructure, focusing on bridging urban-rural divides and ensuring widespread access to affordable Internet services. Comprehensive digital literacy campaigns must be deployed to empower citizens across diverse demographics, addressing disparities in skills and fostering inclusive participation. Public-private partnerships should be actively encouraged, leveraging the expertise of both sectors to drive innovation, infrastructure investments, and localised solutions. Additionally, stringent regulatory frameworks should be implemented to ensure data protection, cybersecurity, and the quality of digital services. By aligning economic ambitions with societal inclusivity, Nigeria can navigate the challenges of technological disruptions, fostering a digitally transformed landscape that benefits all citizens.

This study raised thought-provoking questions and opened an avenue for further research in areas such as:

1. How has the COVID-19 pandemic accelerated digital adoption in education, work, finance, and citizen services?

2. What are the key barriers to inclusive digital access and usage across rural Nigeria's demographic and geographic groups?

3. What policy, infrastructural, and capacity-building strategies are necessary to promote equitable digital transformation across various sectors in Nigeria?

4. How do we identify and propose solutions to the risks associated with emerging technologies in Nigeria?

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