

Emerging Technologies and Inclusive Innovation: Bridging Digital Divides in Developing Economies

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Abstract

Emerging technologies are transforming economic activity, public services, education, healthcare, financial systems, and entrepreneurial ecosystems across the world. Artificial intelligence, mobile technologies, cloud computing, Internet of Things, blockchain, digital financial services, and low-cost connectivity create significant opportunities for developing economies to accelerate innovation and improve access to essential services. However, unequal access to digital infrastructure, affordability constraints, limited digital skills, gender disparities, geographic isolation, and institutional weaknesses continue to create substantial digital divides. This study examines how emerging technologies can support inclusive innovation and contribute to reducing digital inequalities in developing economies. A qualitative and conceptual research methodology based on secondary academic literature, international development reports, and digital-development research is employed. The study analyses digital infrastructure, affordability, digital literacy, inclusive entrepreneurship, financial inclusion, public services, and institutional capacity as major dimensions of digital inclusion. The findings suggest that emerging technologies can contribute to inclusive development when technological innovation is combined with affordable connectivity, appropriate policy frameworks, local capacity building, accessible digital services, and community participation. However, technology adoption alone does not automatically produce inclusion. Without appropriate interventions, emerging technologies may reinforce existing inequalities by benefiting populations with greater income, education, infrastructure, and technological capabilities. The study proposes an inclusive innovation framework based on infrastructure, affordability, skills, accessibility, innovation ecosystems, and responsible governance. The study concludes that bridging digital divides requires a human-centred approach in which technological progress is explicitly aligned with equitable economic and social development.

Keywords: Emerging Technologies, Inclusive Innovation, Digital Divide, Developing Economies, Digital Inclusion, Artificial Intelligence, Digital Financial Inclusion, Digital Literacy, Innovation, Sustainable Development.

1. Introduction

Digital technologies have become increasingly important drivers of economic and social development. The expansion of mobile connectivity, cloud computing, artificial intelligence, digital financial services, online education, telemedicine, and digital marketplaces has created new opportunities for individuals, businesses, and governments.

For developing economies, these technologies can provide an opportunity to accelerate development by allowing institutions and businesses to bypass some traditional infrastructure limitations. Mobile banking, for example, can provide financial services to people who live far from conventional banking institutions. Digital learning platforms can extend educational resources to geographically isolated communities, while telemedicine can improve access to healthcare specialists.

Nevertheless, access to technology remains highly unequal. Individuals living in rural areas may experience limited broadband availability, unreliable electricity, expensive data services, or insufficient digital skills. Women, low-income households, persons with disabilities, older populations, and small businesses may experience additional barriers.

The digital divide should therefore not be understood simply as the difference between people who have internet access and those who do not. It also involves differences in the quality of access, affordability, skills, usage, digital capabilities, and ability to convert technology into meaningful economic and social outcomes.

Emerging technologies create both opportunities and risks in this context. Artificial intelligence may improve agricultural forecasting, healthcare diagnostics, and financial services, but AI systems can also reproduce biases or become inaccessible to communities without adequate digital infrastructure.

Similarly, digital platforms can create new entrepreneurial opportunities while potentially increasing dependence on large technology providers.

Inclusive innovation therefore requires a deliberate effort to ensure that emerging technologies are accessible, affordable, relevant, and beneficial to diverse populations.

This study examines the role of emerging technologies in bridging digital divides and identifies strategies through which developing economies can promote inclusive technological innovation.

2. Literature Review

2.1 The Digital Divide

The digital divide refers to inequalities in access to and effective use of information and communication technologies.

The divide can be considered at multiple levels:

1. **Access divide** – whether people can access digital infrastructure.
2. **Affordability divide** – whether services and devices are financially accessible.
3. **Skills divide** – whether individuals possess sufficient digital literacy.
4. **Usage divide** – whether technology is used effectively and meaningfully.
5. **Outcome divide** – whether digital participation produces tangible social and economic benefits.

Consequently, simply increasing internet penetration may not eliminate digital inequality.

2.2 Inclusive Innovation

Inclusive innovation focuses on creating products, services, processes, and business models that enable disadvantaged or underserved populations to participate in and benefit from innovation.

Inclusive innovation can involve:

- Affordable digital products.
- Low-cost financial services.
- Community-based digital platforms.
- Accessible healthcare technologies.
- Digital education.
- Rural entrepreneurship.
- Assistive technologies.
- Local-language digital services.

The objective is to ensure that innovation benefits are distributed more broadly across society.

3. Research Objectives

This study aims to:

1. Examine the relationship between emerging technologies and inclusive innovation.
2. Identify major dimensions of digital inequality in developing economies.
3. Analyse the role of digital infrastructure and affordability.
4. Examine how emerging technologies can support underserved communities.
5. Identify barriers to inclusive technology adoption.
6. Develop strategies for bridging digital divides through inclusive innovation.

4. Research Methodology

The study adopts a qualitative, conceptual, and literature-based research methodology.

Academic publications, international development reports, digital-economy studies, technology research, and policy documents are reviewed.

The literature is analysed across six dimensions:

- Digital infrastructure.
- Affordability.
- Digital literacy.
- Accessibility.
- Innovation and entrepreneurship.
- Institutional and policy support.

The study subsequently develops an inclusive technology framework linking emerging technologies with digital inclusion and socioeconomic outcomes.

5. Emerging Technologies and Their Inclusive Potential

5.1 Mobile Technologies

Mobile phones are among the most important technologies for expanding digital access in developing economies.

Mobile services can support:

- Digital payments.
- Online education.
- Agricultural information.
- Healthcare communication.
- Government services.
- Employment opportunities.
- Entrepreneurship.

The widespread availability of mobile devices makes mobile-first strategies particularly relevant where fixed broadband infrastructure remains limited.

5.2 Artificial Intelligence

AI can support inclusive development in areas such as:

- Agricultural yield prediction.
- Disease-risk assessment.
- Language translation.
- Educational personalization.
- Financial risk assessment.
- Disaster forecasting.
- Public-service delivery.

However, AI systems must be designed carefully to avoid excluding populations whose languages, socioeconomic characteristics, or behavioural patterns are poorly represented in training datasets.

5.3 Cloud Computing

Cloud computing enables organizations to access advanced digital infrastructure without building expensive local data centres.

For small businesses and public institutions, cloud services can reduce technology costs and enable access to software, data storage, analytics, and collaboration tools.

5.4 Digital Financial Technologies

FinTech has significant potential to promote financial inclusion.

Mobile wallets, digital payments, digital banking, and alternative credit systems can provide financial services to populations traditionally excluded from formal banking.

However, digital financial inclusion requires consumer protection, cybersecurity, financial literacy, and affordable access.

5.5 Internet of Things

IoT technologies can support inclusive development through applications in agriculture, water management, healthcare, transport, and energy.

For example, low-cost agricultural sensors can provide farmers with information about soil conditions, irrigation requirements, and environmental conditions.

Table 1. Emerging Technologies and Inclusive Development Opportunities

Technology	Application	Potential Inclusive Outcome
Mobile Technologies	Digital services	Wider connectivity
AI	Healthcare and agriculture	Improved decision support
Cloud Computing	Business applications	Lower technology costs
FinTech	Digital payments	Financial inclusion
IoT	Smart agriculture	Improved productivity
Digital Platforms	Market access	Entrepreneurial opportunities
Blockchain	Digital records	Greater transaction transparency
Telemedicine	Remote healthcare	Improved healthcare access

6. Major Dimensions of the Digital Divide

6.1 Infrastructure Divide

Rural and remote communities may have limited broadband infrastructure, unreliable electricity, and inadequate network coverage.

Infrastructure development remains the foundation of meaningful digital inclusion.

6.2 Affordability Divide

Even when connectivity is technically available, high costs can prevent low-income households from accessing devices and internet services.

Affordable data packages, shared infrastructure, public access points, and appropriate taxation policies can improve accessibility.

6.3 Digital Skills Divide

Individuals require more than internet access. They need the skills to search for information, communicate, transact online, protect their privacy, and use digital services effectively.

Digital-literacy programmes should therefore be integrated into education, employment, and community-development initiatives.

6.4 Gender Digital Divide

In many developing economies, women face additional barriers to digital participation, including limited access to devices, financial constraints, social restrictions, and lower levels of digital skills.

Gender-responsive digital policies can help reduce these disparities.

6.5 Rural–Urban Divide

Urban populations often benefit from better infrastructure, greater access to digital businesses, and stronger technology ecosystems.

Rural communities require targeted policies supporting connectivity, digital skills, local entrepreneurship, and relevant digital services.

7. Digital Entrepreneurship and Inclusive Innovation

Emerging technologies can reduce entry barriers for entrepreneurs.

Digital platforms allow small businesses to reach customers without establishing expensive physical stores. Social-commerce platforms can enable micro-enterprises to market products beyond their immediate communities.

Cloud computing can provide affordable access to business software, while digital payments allow small firms to participate in increasingly digital marketplaces.

For developing economies, these capabilities can contribute to employment creation and local economic development.

However, inclusive digital entrepreneurship requires more than platforms. Entrepreneurs need access to finance, digital skills, reliable connectivity, business knowledge, and supportive regulatory environments.

8. Case Study: Digital Agriculture for Smallholder Farmers

Consider a rural agricultural region where smallholder farmers have limited access to agricultural specialists and real-time market information.

A mobile-based digital platform provides farmers with:

- Weather forecasts.
- Crop-management recommendations.
- Market prices.
- Pest alerts.
- Digital payment services.
- Information about agricultural support programmes.

AI models can analyse weather and crop information to generate localized recommendations.

Farmers can also use digital marketplaces to connect directly with buyers.

Such a system can reduce information asymmetry and improve farmers' ability to make production and marketing decisions.

However, successful implementation requires affordable mobile access, local-language support, digital literacy, and reliable connectivity.

9. Data Analysis

The conceptual analysis indicates that digital infrastructure, affordability, and digital skills are interconnected determinants of inclusive technology adoption.

Technology availability without affordability produces limited inclusion. Similarly, affordable connectivity without adequate skills may not produce meaningful socioeconomic benefits.

Therefore, digital inclusion should be approached as a multidimensional development challenge.

Table 2. Dimensions of Digital Inclusion

Dimension	Key Requirement	Potential Barrier
Infrastructure	Broadband and electricity	Geographic isolation
Affordability	Low-cost devices and data	Household income
Skills	Digital literacy	Education gaps
Accessibility	Inclusive interfaces	Disability and language barriers
Usage	Relevant digital services	Lack of awareness
Entrepreneurship	Digital business support	Limited finance
Trust	Security and privacy	Cybersecurity concerns

Dimension	Key Requirement	Potential Barrier
Outcomes	Economic and social benefits	Unequal capabilities

Note: Table 2 represents a conceptual framework and does not contain results from a primary household survey.

10. Barriers to Inclusive Innovation

10.1 Infrastructure Gaps

Limited telecommunications infrastructure can prevent entire communities from participating in the digital economy.

10.2 Financial Constraints

Low-income households may be unable to purchase smartphones, computers, or reliable internet services.

10.3 Digital Literacy

Lack of digital skills reduces the ability of individuals to benefit from available technologies.

10.4 Language Barriers

Many digital platforms are designed primarily for major global languages. Local-language interfaces are essential for broader inclusion.

10.5 Cybersecurity and Privacy

Individuals who are new to digital technologies may be particularly vulnerable to fraud, identity theft, and other cyber risks.

10.6 Institutional Capacity

Governments and local institutions may lack the expertise required to implement large-scale digital inclusion programmes.

11. Policy Framework for Bridging Digital Divides

A comprehensive digital-inclusion strategy can be structured around seven pillars:

Connectivity → Affordability → Skills → Accessibility → Innovation → Trust → Outcomes

Connectivity

Expand broadband, mobile networks, electricity infrastructure, and public internet facilities.

Affordability

Support affordable devices and internet access for low-income communities.

Skills

Implement digital-literacy and technology-training programmes.

Accessibility

Ensure that digital services are accessible to women, persons with disabilities, rural communities, older populations, and linguistic minorities.

Innovation

Support local technology entrepreneurs and inclusive digital business models.

Trust

Strengthen cybersecurity, privacy, consumer protection, and digital identity systems.

Outcomes

Measure whether digital programmes produce actual improvements in income, employment, education, healthcare, and public-service access.

12. Role of Governments

Governments have a central role in establishing an enabling environment for inclusive technological innovation.

Policy priorities should include:

1. Expanding broadband infrastructure.
2. Supporting affordable internet access.
3. Developing digital-literacy programmes.
4. Promoting local-language digital services.
5. Supporting women-led digital entrepreneurship.
6. Strengthening cybersecurity and privacy.
7. Encouraging public-private partnerships.
8. Supporting local innovation ecosystems.
9. Improving digital public services.
10. Measuring digital-inclusion outcomes.

13. Discussion

Emerging technologies offer developing economies an opportunity to accelerate economic and social development. However, technology is not inherently inclusive.

Without deliberate policy intervention, digital transformation may increase inequality because individuals with higher incomes, stronger education, better infrastructure, and greater technological capabilities are often positioned to benefit first.

Inclusive innovation therefore requires a shift from a technology-first approach toward a people-centred approach.

The relevant question is not simply whether a new technology is available, but whether underserved populations can afford it, understand it, trust it, and use it to improve their livelihoods.

This distinction is particularly important for artificial intelligence. Advanced AI applications may create major economic benefits, but those benefits can remain concentrated if developing economies lack computing infrastructure, high-quality datasets, skilled professionals, and appropriate governance mechanisms.

Developing countries should therefore pursue technology strategies that emphasize accessibility, local capacity building, and practical applications addressing community needs.

14. Strategic Recommendations

1. Prioritize Universal Connectivity

Governments should treat affordable and reliable connectivity as essential development infrastructure.

2. Promote Affordable Devices

Policies should support access to affordable smartphones, computers, and other digital devices.

3. Expand Digital-Literacy Programmes

Training should focus on practical skills relevant to education, employment, entrepreneurship, healthcare, and financial services.

4. Support Local Innovation

Start-ups and community innovators should be encouraged to develop solutions addressing local problems.

5. Encourage Local-Language Technologies

Digital platforms should support local languages and culturally relevant interfaces.

6. Promote Inclusive Digital Finance

Digital financial services should be accompanied by financial literacy, consumer protection, and cybersecurity measures.

7. Strengthen Public–Private Partnerships

Governments, telecommunications providers, technology companies, universities, and civil-society organizations can jointly develop scalable inclusion programmes.

8. Measure Real Outcomes

Digital-inclusion programmes should measure changes in income, employment, education, healthcare access, and quality of life rather than connectivity alone.

15. Questionnaire

5-Point Likert Scale: 1 = Strongly Disagree, 5 = Strongly Agree

No.	Statement
1	Emerging technologies can improve economic opportunities in developing economies.
2	Affordable internet access is essential for digital inclusion.
3	Digital literacy significantly influences technology adoption.
4	Mobile technologies can reduce geographical barriers to services.
5	Digital financial services can improve financial inclusion.
6	AI can support inclusive healthcare and agricultural development.
7	Women face significant barriers to digital participation in many developing communities.
8	Local-language digital services are necessary for inclusive innovation.
9	Governments should provide greater support for digital entrepreneurship.
10	Emerging technologies can contribute to reducing socioeconomic inequalities when appropriately governed.

16. Future Research Directions

Future research should conduct empirical household-level studies examining the relationship between digital access and socioeconomic outcomes.

Longitudinal studies could investigate whether increased digital connectivity produces sustained improvements in employment, income, education, and entrepreneurship.

Researchers should also examine the gender dimension of digital inclusion, particularly the relationship between smartphone ownership, digital financial services, and women's entrepreneurial participation.

Another important area is AI inclusion. Future research should investigate whether developing economies can build locally relevant AI systems using regional languages, local datasets, and affordable computational infrastructure.

Research should also examine the environmental dimension of digital inclusion. Expanding digital infrastructure requires electricity, hardware, and data infrastructure. Future policies should therefore consider the sustainability of digital expansion.

17. Conclusion

Emerging technologies provide developing economies with significant opportunities to accelerate inclusive economic and social development. Mobile technologies, artificial intelligence, cloud computing, digital financial services, IoT, and digital platforms can expand access to education, healthcare, finance, markets, and employment.

However, technology adoption alone cannot eliminate digital inequality. Digital divides are multidimensional and include differences in infrastructure, affordability, skills, accessibility, usage, and socioeconomic outcomes.

The study concludes that inclusive innovation requires technology to be combined with human capabilities, affordable infrastructure, supportive institutions, and responsible governance.

Developing economies should therefore adopt a people-centred digital-development strategy in which technological progress is evaluated according to its ability to improve the lives and opportunities of underserved populations.

Bridging the digital divide is ultimately not only a technological challenge but also an economic, institutional, educational, and social-development challenge.

References

1. World Bank. (2016). World Development Report 2016: Digital Dividends. World Bank.
2. World Bank. (2024). Digital Progress and Trends Report 2023. World Bank.
3. International Telecommunication Union. (2024). Facts and Figures 2024. ITU.
4. United Nations. (2024). United Nations E-Government Survey 2024. United Nations.
5. United Nations Conference on Trade and Development. (2024). Digital Economy Report 2024. United Nations.
6. Organisation for Economic Co-operation and Development. (2021). Bridging the Digital Divide: A Review of Digital Inclusion Policies. OECD.
7. International Telecommunication Union. (2021). Digital Trends in the Least Developed Countries. ITU.
8. van Dijk, Jan A. G. M.. (2020). The Digital Divide. Polity Press.
9. Heeks, Richard. (2018). Information and communication technology for development. Routledge.
10. Nambisan, Satish, Wright, Mike, & Feldman, Maryann. (2019). The digital transformation of innovation and entrepreneurship. *Research Policy*, 48(8), 103773.
11. George, Gerard, Merrill, Ryan K., & Schillebeeckx, Simon J. D. (2021). Digital sustainability and entrepreneurship. *Academy of Management Journal*, 64(2), 399–423.

12. Cecchini, Simone, & Scott, Christopher. (2003). Can information and communications technology applications contribute to poverty reduction? *Information Technology for Development*, 10(2), 91–112.
13. Aker, Jenny C., & Mbiti, Isaac M. (2010). Mobile phones and economic development in Africa. *Journal of Economic Perspectives*, 24(3), 207–232.
14. Donner, Jonathan. (2008). Research approaches to mobile use in the developing world: A review of the literature. *The Information Society*, 24(3), 140–159.
15. Demirgüç-Kunt, Asli, Klapper, Leora, Singer, Dorothe, Ansar, Saniya, & Hess, Jake. (2022). *The Global Findex Database 2021*. World Bank.