

DIGITAL EQUITY IN SUB-SAHARAN AFRICA: BRIDGING THE EDUCATIONAL DIVIDE

Margaret Bola Oni

Human Capital Policy Department

Nigerian Institute of Social and Economic Research (NISER)

mbiodunoni@yahoo.com. Mobile: 08034027595

Abstract

This study explores the digital equity in Sub-Saharan Africa, focusing on its implications for educational access, inclusion, and outcomes. Drawing on recent literature (2019-2025) and a systematic literature review and secondary data analysis approach, the research identifies key barriers to digital inclusion, including infrastructural deficits, low digital literacy, and limited assistive technologies. A conceptual framework grounded in Resources and Appropriation Theory links policy support, access, skills, and meaningful use to educational outcomes. Findings reveal that South Africa (70%) tops the internet penetration, with a 20% divide between the urban and rural, while Uganda (30%), with digital access 40% between urban and rural, is at the base among the selected countries. Skill deficits, affordability, and connectivity gaps were the observed barriers to policy reforms and inclusion as enablers. Strategic vision and capacity building were among the policy and practice frameworks for bridging the divide. The study concludes that the digital divides in sub-Saharan Africa are real and have multifaceted implications; therefore, stakeholders must prioritise equity at every level from national policy to classroom practice.

Keywords: Digital equity, Sub-Saharan Africa, educational technology, inclusion, digital literacy

Introduction

In the 21st century, digital technologies have become indispensable to educational delivery, access, and equity. Yet, in Sub-Saharan Africa (SSA), the promise of digital transformation remains unevenly distributed. While global education systems increasingly integrate digital tools to enhance learning outcomes, SSA continues to grapple with infrastructural deficits, socio-economic disparities, and policy gaps that widen the digital divide (Baidoo-Anu et al., 2023). The COVID-19 pandemic further exposed these vulnerabilities, revealing stark contrasts in digital readiness between urban and rural communities, as well as between high-income and low-income nations (Mouongue & Rutazihana, 2024). Digital equity refers not only to access to devices and connectivity but also to the capacity to use digital tools meaningfully for learning, teaching, and innovation. In Sub-Saharan Africa, digital equity is a critical determinant of educational inclusion, particularly for marginalised populations such as girls, rural learners, and students with disabilities. Bridging this divide is essential for achieving Sustainable Development Goal 4 (SDG 4), which aims to ensure inclusive and equitable quality education for all.

Digital equity in education encompasses three interrelated dimensions: access, which is the availability of devices, internet, and electricity; skills, which involve digital literacy among students and educators; and meaningful use, which is integrating technology into pedagogy and curriculum. These dimensions are shaped by broader systemic factors, including income inequality, gender norms, geographic isolation, and policy frameworks (Constancio, 2024). In SSA, digital equity is not just about connectivity; it is about empowerment, participation, and the right to learn. Recent studies show that students in rural Sub-Saharan Africa communities often lack basic access to computers and stable internet, making online learning nearly impossible (Baidoo-Anu et al., 2023). Even where infrastructure exists, affordability and digital literacy remain significant barriers (Constancio, 2024).

Statement of the Problem

Governments and institutions across Sub-Saharan Africa have initiated digital transformation strategies, but these efforts are often fragmented and underfunded. For instance, the University of Dodoma in Tanzania has implemented digital literacy programs, yet many students still lack basic competencies due to curriculum gaps and limited resources. Also, in South Africa, mobile technology has expanded internet access. Still, disparities persist in rural and low-income communities, signifying that policy reforms must prioritise inclusive infrastructure, teacher training, and curriculum redesign to ensure that digital tools enhance, not hinder, educational equity.

Objectives of the Study

The objectives of this study are:

1. To critically examine the state of digital equity in SSA education.
2. To identify barriers and enablers of digital inclusion.

3. To propose policy and practice frameworks for bridging the educational divide.

Literature Review

Digital Equity, Literacy, Integration and Gap

Digital equity has evolved from a narrow focus on access to a broader framework encompassing skills, meaningful use, and outcomes. Van Dijk and Van Deursen's (2020) *Resources and Appropriation Theory* remains foundational, arguing that digital access is mediated by socio-economic status, education, and geography. In the Sub-Saharan African (SSA) context, this theory is particularly relevant due to entrenched inequalities that shape digital engagement (Constancio, 2024). Constancio's systematic review of 54 studies found that digital divide research in SSA often lacks contextual nuance, with an underrepresentation of rural and marginalised populations. He emphasises the need for localised frameworks that account for cultural, linguistic, and infrastructural diversity. Access to digital infrastructure remains a major barrier in SSA. Mouongue and Rutazihana (2024) analysed data from 29 SSA countries and found that internet and mobile cellular subscription gaps significantly correlate with lower secondary school enrollment and completion rates. Their regression models revealed that increased government spending on education, and electricity access positively influenced digital equity outcomes.

Ndibalema (2025) highlights the infrastructural challenges in higher education, noting that many universities lack the bandwidth, hardware, and technical support needed to sustain digital learning. His review of 14 empirical studies found that outdated ICT policies and unprepared lecturers hinder the development of 21st-century skills. Digital literacy is not just a technical skill; it's a pedagogical imperative. Ndibalema (2025) argues that without digital fluency, students cannot fully engage with online platforms or develop critical thinking and problem-solving abilities. His findings show that digital literacy gaps are most pronounced in rural institutions, where professional development for educators is limited. Moreover, Fernandez et al. (2023) and Habib (2023) suggest that digital literacy should be embedded into curricula as a core competency, not an optional add-on. Universities must prioritise digital culture, global mobility, and democratisation of knowledge to prepare students for a tech-driven world. Ajani and Gamede (2021) explore gendered barriers to digital education in rural Africa. Their study reveals that girls are less likely to own devices, have internet access, or receive digital training. Cultural norms and economic constraints further marginalise female learners, especially in STEM fields. Benkhadra (2025) adds that children with disabilities face systemic exclusion due to inaccessible platforms and a lack of assistive technologies. Her research calls for inclusive design principles and targeted interventions to ensure that digital transformation does not leave vulnerable populations behind. A cross-national study of 29 SSA countries found that disparity in internet and mobile cellular subscriptions significantly correlates with lower secondary school enrollment and completion rates (Mouongue & Rutazihana, 2024). Moreover, increased government expenditure on education and electricity access was positively associated with improved digital equity outcomes. Another study focusing on Ghana revealed that most students had no prior experience with online learning, lacked mental health support, and struggled to navigate digital platforms during the pandemic (Baidoo-Anu et al., 2023). These findings underscore the urgency of systemic interventions beyond infrastructure to include capacity building, policy reform, and inclusive design.

Resources and Appropriation Theory

This study draws on the Resources and Appropriation Theory (Van Dijk & Van Deursen, 2020), which posits that digital access is mediated by personal and positional categories -such as socio-economic status, education level, and geographic location. The framework identifies three levels of digital divide: access divide: Physical availability of technology, skills divide: Ability to use technology effectively and outcome divide: Benefits derived from digital engagement. This theory is particularly relevant in Sub-Saharan Africa, where structural inequalities intersect with digital exclusion, reinforcing educational disparities (Constancio, 2024).

Recent studies underscore the severity of the digital divide in Sub-Saharan Africa. A pooled analysis of 29 Sub-Saharan Africa countries revealed gaps in internet and mobile cellular subscriptions significantly correlate with lower secondary school enrollment and completion rates (Mouongue & Rutazihana, 2024). In Tanzania, a systematic review found that inadequate digital infrastructure and unprepared lecturers hinder the development of 21st-century skills among university students (Ndibalema, 2025). In Uganda, children with disabilities were disproportionately excluded from digital learning due to inaccessible platforms and a lack of assistive technologies (Benkhadra, 2025). These findings highlight that digital equity is not a monolith; it varies across regions, populations, and educational levels.

Conceptual Framework

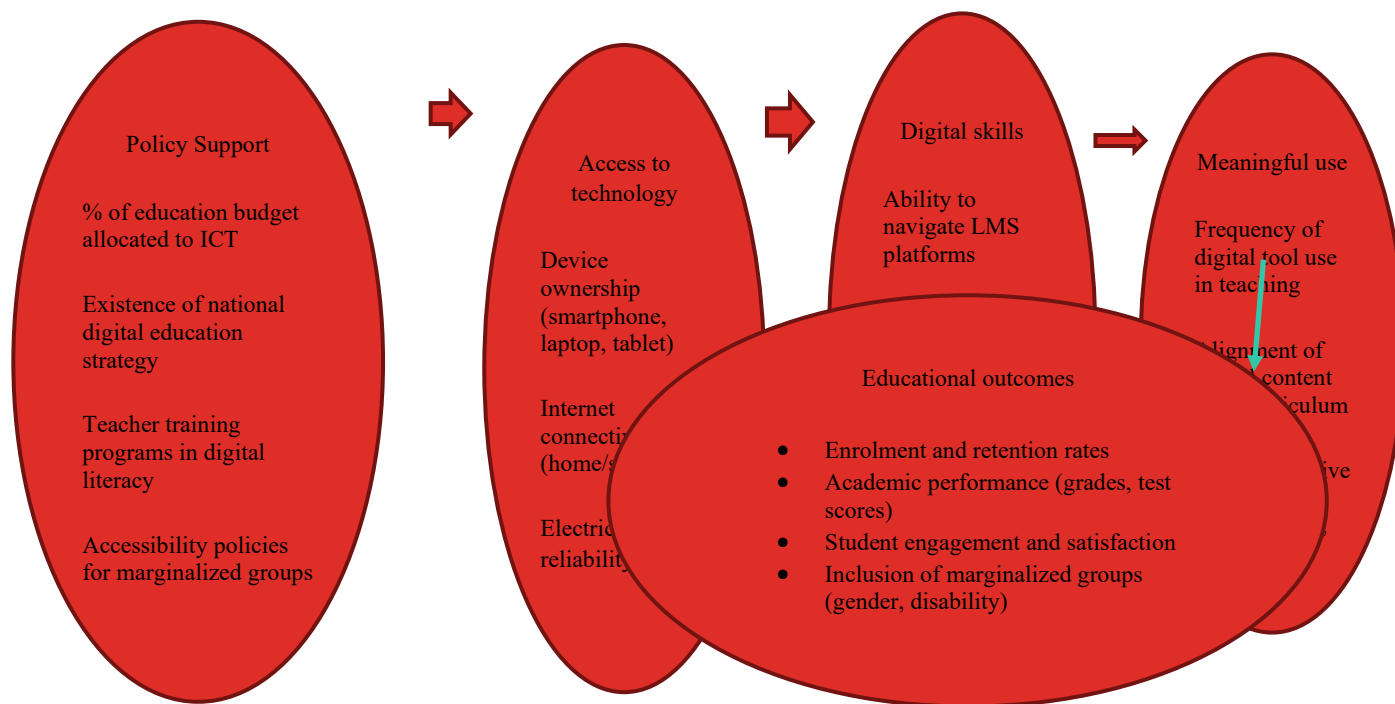


Figure 1: Conceptual Framework
Source: Author (2025)

The conceptual framework in Figure 1 shows a network of policy support which include budget, existence of national digital education strategy and training programmes in digital literacy dovetailing to access to technology such as device ownership, internet connectivity and electricity reliability. Also in the framework is subsequent impact of digital skills encompassing ability to navigate learning management system platforms, use of content creation tools and data analysis proficiency on meaningful use which include frequency of digital tool use in teaching, alignment of digital content with curriculum and use of inclusive design. And lastly, the resulting effects on educational outcomes like enrollment and retention rates, academic performance, student engagement and satisfaction, inclusion of marginalized groups among others.

Methodology

Research Design

This study employs a mixed-methods approach, combining quantitative analysis of regional data with qualitative insights from case studies and policy documents. The rationale for this design is to capture both the breadth of digital equity disparities across Sub-Saharan Africa (SSA) and the depth of lived experiences and institutional responses. The quantitative component uses secondary data from international databases and peer-reviewed studies, while the qualitative component synthesises findings from recent literature, government reports, and institutional case studies. This approach aligns with Constancio's (2024) recommendation for contextualised digital divide research that integrates multiple perspectives and avoids theory-ladenness.

Sampling Technique and Sample

The study covers seven Sub-Saharan African countries, selected based on data availability and regional representation. Countries include Nigeria, Kenya, Ghana, Tanzania, South Africa, Uganda, and Rwanda. For qualitative synthesis, three case studies were selected as follows: University of Dodoma (Tanzania): digital literacy program implementation,

University of Cape Town (South Africa): Mobile technology integration and University of Ghana: post-pandemic digital recovery strategies. These cases were chosen for their diversity in institutional capacity, geographic location, and policy engagement.

Method of Collection and Analysis

Quantitative Data were sourced from the World Bank Education Statistics (2020–2024). These are from World Bank and Digital Development Partnership based on Digital House Survey DHS of 48 countries in African countries on Enrolment rates, internet penetration, mobile cellular subscriptions, UNESCO Institute for Statistics: Data on ICT access in schools and teacher training and National Education Ministries: Country-specific reports on digital education initiatives, while the qualitative Data were obtained from peer-reviewed studies from journals such as *Policy Futures in Education*, *Innovation and Education*, and *Cogent Education*, institutional case studies from universities in Tanzania, South Africa, and Ghana and policy documents from ministries of education and ICT. The reason for selecting these three universities is the availability and evidence of digital literacy programs in those institutions. The collected data were content analysed by extracting themes relevant to the specific objectives of the study.

Ethical Considerations

Although this study relies on secondary data, ethical integrity was maintained by citing all sources transparently, avoiding misrepresentation of vulnerable populations, and respecting cultural contexts in interpreting findings. The study also adheres to the Global Campus of Human Rights guidelines for inclusive education research. Policy frameworks across SSA vary widely in scope and effectiveness, while some governments have launched digital education strategies, implementation remains inconsistent. For example, the University of Dodoma in Tanzania has introduced digital literacy programs, but curriculum gaps and resource constraints persist (Ndibalema, 2025). Durevall (2025) emphasises the role of mobile technology in expanding access, particularly in South Africa. However, he cautions that without parallel investments in teacher training and curriculum reform, technology alone cannot close the equity gap.

Results

Table 1: Internet Penetration, Access and Digital Divides (2024)

Country	Internet Penetration (%)	Urban Penetration (%)	Rural Penetration (%)	Smartphone Penetration (%)
Nigeria	54	~70	~30	~40
Kenya	60	~75	~40	~50
Ghana	50	~65	~35	~38
Tanzania	35	~55	~15	~25
South Africa	70	~80	~60	~60
Uganda	30	~50	~10	~22
Rwanda	40	~60	~20	~30

Source: World Bank and Digital Development Partnership DDP 92023)

Table 1 presents the internet penetration, access and digital divides in the sub-sahara Africa. The data presented were from World Bank and digital development partnership based on Digital House Survey DHS of 48 countries in African countries. The findings reveal persistent disparities in digital access, literacy, and inclusion across Sub-Saharan Africa (SSA). The table revealed that South Africa (70%) top the internet penetration with 20% divide between the urban and rural. The trend

continues through Tanzania (35%) penetration with about 40% access divide and lastly Uganda (30%) penetration with digital access divide of 40% between urban and rural. While some progress has been made post-COVID-19, structural barriers continue to hinder equitable digital transformation in education.

Table 2: Barriers and Enablers of Digital Inclusion in SSA

Country	Barriers	Enablers
Nigeria	Infrastructure gaps, inconsistent electricity, high data/device costs, gender & rural divides, weak policy implementation	Government digital literacy programs, public/private partnerships, and renewable energy projects
Kenya	Rural infrastructure deficits, affordability of services, and socio-economic disparities	Broadband rollout, innovation hubs, fintech expansion, and strong government digital initiatives
Ghana	Rural-urban access divide, affordability issues, and limited digital skills in rural areas	Youth digital skill programs, improving broadband, and community education initiatives
Tanzania	Electricity shortages, low internet infrastructure, and digital literacy gaps	Policy reforms, NGO/community digital inclusion programs
South Africa	Cost barriers and the digital divide persist in marginalised groups	Advanced broadband infrastructure, strong governance, literacy campaigns
Uganda	Lack of reliable power, poverty, and rural digital illiteracy	Renewable energy access, community training & inclusion efforts
Rwanda	Economic constraints, rural connectivity challenges	Government-led digital inclusion policies, training programs

Table 2 shows the barriers and enablers of digital inclusion in sub-Saharan Africa. The table revealed that barriers that are most prevalent across all the selected countries, skill deficits, affordability and connectivity gaps. The table also revealed the prevalent enablers such as policy reforms, literacy and campaign on inclusion efforts. The complexity of digital inclusion is a multi-layered social challenge requiring coordinated efforts to reduce inequities and enable meaningful digital participation by all groups, especially marginalised communities. The results advocate for strategic alignment of enablers with identified barriers to achieve equitable access and usage. This is addressed in the next research objective.

Table 3: Policies and Practices for Bridging the Divide

Framework Aspect	Description	Key Actions/Components	Stakeholders Involved
Strategic Vision	National or regional digital learning vision aligned with inclusion and equity goals	Policy guidelines, aligned digital education strategies	Governments, education ministries
Infrastructure & Access	Ensuring affordable, reliable internet and digital device availability	Subsidies, public access points, and device distribution programs	Telecoms, public sector, private partners
Capacity Building	Digital literacy development for students, teachers, and communities	Training programs, curriculum integration, and continuous skilling	Schools, teacher training institutions, NGOs
Inclusive Content & Design	Developing accessible and locally relevant digital learning content	Multilingual resources, disability-accessible platforms	Content developers, education tech firms
Technology Integration	Leveraging emerging technologies such as AI ethically to enhance learning	Personalised learning tools, data-driven decision making	EdTech firms, researchers
Multi-stakeholder Collaboration	Coordinated efforts among government, private sector, NGOs, and communities	Cross-sector partnerships, international cooperation	All sectors
Monitoring and Evaluation	Systems to track implementation, measure impact, and adjust strategies	Data collection, reporting, feedback loops	Policy makers, education researchers

Table 3 shows the policy and practice frameworks for bridging the divide. The table revealed that the policy frameworks, description, key actions and the stakeholders involved in the frameworks. Capacity building, infrastructure access, technology integration, inclusive content and design, multi stakeholder collaboration, monitoring and evaluation were the observed policy frameworks across the selected countries. These frameworks were backed by respective key actions: training programmes, curriculum integration, continuous skilling, public access points and subsidies, personalised learning tools, data collection, reporting and feedback loops.

This finding shows that assistive technology remains under-utilised, especially outside South Africa. While investment is growing, it remains modest relative to need. Durevall (2025) argued that mobile tech alone cannot close the equity gap without parallel investments in pedagogy and infrastructure.

Discussion of Findings

The result on the internet penetration, access and digital divides in the sub-sahara Africa revealed persistent disparities in digital access, literacy, and inclusion across Sub-Saharan Africa (SSA). South Africa topped the internet penetration with mild divide between the urban and rural. Tanzania followed in line of internet penetration with more access divide and

lastly Uganda less digital access more divide between urban and rural. While some progress has been made post-COVID-19, structural barriers continue to hinder equitable digital transformation in education.

The result of this study supports that of Mouongue & Rutazihana's (2024) findings who reported that internet access strongly correlates with school enrollment. Countries with higher digital penetration, like South Africa and Kenya, show better educational outcomes. This finding is also in tandem with that of Jinadu, Oyaremi and Rufai (2021) and Jinadu and Okwilagwe (2025) who independently found out that technology is disrupting and shaping different educational landscape with a varying degree of acceptance and adoption across digital natives and digital immigrants. This result is also in tune with the findings of Otunla and Jinadu (2014) who investigated university lecturer adoption of new educational technologies for effective service delivery in undergraduate medical education. The scholar reported a significant difference in the adoption of new technologies across gender and across ages among university lecturers.

The finding on the barriers and enablers of digital inclusion in sub-Saharan Africa revealed that barriers that are most prevalent across all the selected countries are skill deficits, affordability and connectivity gaps. The finding also revealed the prevalent enablers such as policy reforms, literacy and campaign on inclusion efforts. The result of this study agrees well with that of Baidoo-Anu et al (2023) who found out that while smartphones are widely owned, laptops and tablets essential for academic work are less accessible. This confirms a shift from access divide to use divide, as students struggle with functionality and platform compatibility. The complexity of digital inclusion is a multi-layered social challenge requiring coordinated efforts to reduce inequities and enable meaningful digital participation by all groups, especially marginalised communities. The results advocate for strategic alignment of enablers with identified barriers to achieve equitable access and usage.

The result on the policy and practice frameworks for bridging the digital divide revealed that the policy frameworks, description, key actions and the stakeholders involved in the frameworks were suggested. Capacity building, infrastructure access, technology integration, inclusive content and design, multi stakeholder collaboration, monitoring and evaluation were the observed policy frameworks across the selected countries. These frameworks were backed by respective key actions: training programmes, curriculum integration, continuous skilling, public access points and subsidies, personalised learning tools, data collection, reporting and feedback loops.

The result of this study on the policy and practice frameworks for bridging the digital divide corroborates that of Ndibalema (2025) who highlighted efforts to bridge gaps in educator preparedness, especially in higher-order digital skills. These findings reinforce the need for targeted professional development and curriculum reform. The result is also in tandem with Ajani & Gamede (2021) who observed that girls face cultural and economic barriers to digital access which underscores the need for gender-sensitive digital policies. Also, Benkhadra (2025) emphasised the exclusion of children with disabilities due to a lack of inclusive design. These findings show that assistive technology remains under-utilised, especially outside South Africa. While investment is growing, it remains modest relative to need. Durevall (2025) argued that mobile tech alone cannot close the equity gap without parallel investments in pedagogy and infrastructure.

Conclusion

The study established that digital equity in Sub-Saharan Africa is not merely a technological challenge but also a multidimensional issue rooted in structural inequalities, policy gaps, and socio-cultural dynamics. This study has shown that while access to devices and connectivity is improving in some regions, meaningful use and digital literacy remain significant barriers to educational inclusion. Limited assistive technologies and uneven policy implementation continue to widen the divide. The conceptual framework illustrates how policy support, infrastructure, skills, and pedagogical integration must work in tandem to produce equitable educational outcomes. Bridging the digital divide requires more than hardware it demands human-centred design, inclusive pedagogy, and sustained investment in capacity building. It is therefore recommended that stakeholders must prioritise equity at every level from national policy to classroom practice. Only then can technology fulfill its promise as an empowerment, inclusion, and lifelong learning tool. Meanwhile, the current study relied heavily on secondary data, thereby limiting scope of case studies, generalizability and thus suggests avenues for further research in this area using primary data.

References

- Ajani, O. A., & Gamede, B. T. (2021). Gendered barriers to digital education in rural Africa. *Journal of African Educational Research*, 5(2), 45–63.
- Baidoo-Anu, D., Gyamerah, K., & Munezhi, M. (2023). Digital divide in higher education in Sub-Saharan Africa: Evidence from online learning during the COVID-19 pandemic. *SN Social Sciences*, 3(122).

Benkhadra, R. (2025). Bridging or widening the gap? Assessing digitalisation's impact on inclusive education for vulnerable children in Africa. *Global Campus of Human Rights*.

Constancio, F. (2024). The digital divide research in sub-Saharan education: Representations, localisation of elements, and theoretical implications. *Policy Futures in Education*.

Durevall, D. (2025). Digital development and educational outcomes in Sub-Saharan Africa. *University of Gothenburg Research Project*.

Jinadu, A. T. & Okwilagwe, E. (2025). Assessment and modelling of research undertaking, digital-technology construct and researchers' statistical software skills. *International Journal of Research in Education and Science (IJRES)*, 11(4), 759-778. <https://doi.org/10.46328/ijres.3724>

Jinadu, A. T., Oyaremi, M. K. & Rufai, M. D. (2021). Assessment of the Oyo state teaching service commission interactive learning platforms during covid_19 lockdown period in Nigeria. *Interdisciplinary Journal of Educational Research*, Volume 3 (1) 37-44. <http://doi.org/10.51986/ijer-2021.vol3.01.04>

Mouongue, A. K., & Rutazihana, P. N. (2024). Digital Divide and its Implications for Education in the Post-COVID-19 Era in Sub-Saharan Africa. *Innovation and Education*, 6(2), 108–132.

Ndibalema, P. (2025). Digital literacy gaps in promoting 21st-century skills among students in higher education institutions in Sub-Saharan Africa: A systematic review. *Cogent Education*, 12(1), 24-52.

Nnstancio, F. (2024). The digital divide research in sub-Saharan education: Representations, localisation of elements, and theoretical implications. *Policy Futures in Education*.

Otunla, A. O. & Jinadu, A. T. (2014). University Lecturers' Adoption of New Educational Technologies for Effective Service Delivery in Undergraduate Medical Education. *Journal of Educational Media and Technology*. Volume 18 (1), pages 48-54.

Van Dijk, J., & Van Deursen, A. (2020). *The Digital Divide: Resources and Appropriation Theory*. Amsterdam University Press.