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Digital Literacy, AI, and Rural Connectivity: Addressing Sociological Barriers to Inclusive Education

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Abstract: Rural learners continue to face systemic exclusion from the benefits of digital transformation, as limited connectivity, low digital literacy, and sociocultural biases embedded in emerging technologies restrict their participation in digital education. This study investigates these inequalities using a qualitative methodology informed by digital sociology and critical theory, framing digital technologies and AI not as neutral tools but as socio-technical systems that reproduce existing power structures. Drawing on interviews, classroom observations, and community documents across rural educational settings, the research finds that unstable infrastructure, limited teacher preparedness, and linguistic biases in AI-driven platforms significantly hinder rural learners' engagement. At the same time, communities demonstrate considerable resilience through local innovation, including digital hubs, offline learning tools, and volunteer-led digital literacy initiatives. The study argues that addressing these inequities requires "digital equity by design," a framework that emphasises culturally responsive AI, inclusive policy-making, and community participation. By foregrounding the sociological dimensions of digital inequality, the research contributes new insights into the politics of educational technology and highlights strategies for building more just, inclusive digital futures for marginalised rural learners.

Keywords: AI bias; rural digital literacy, community-led innovation, digital equity, educational technology, social inequality

INTRODUCTION

The integration of digital technologies and artificial intelligence (AI) into contemporary education systems is reshaping the nature of learning, teaching, and knowledge creation. In many countries, digital learning platforms, AI-driven assessment tools, and online pedagogies have become essential components of educational access and participation. However, the promise of digital transformation remains unevenly realised. While urban and affluent communities increasingly benefit from enhanced connectivity and advanced technological infrastructures, rural learners continue to face systemic barriers that limit their ability to participate in digital education. These divides extend beyond technical gaps in connectivity to include socio-economic, cultural, linguistic, and pedagogical inequalities that reflect longstanding structural disparities. Understanding these dynamics requires an analytical shift from treating digital exclusion as a technological deficiency to recognising it as a sociological phenomenon embedded within wider power structures (Lupton, 2015).

Digital sociology provides a critical lens through which to interrogate the role of technology in reproducing or challenging social inequalities. This approach situates digital technologies within broader political, economic, and cultural contexts, emphasising that technology is never neutral but is shaped by social relations and institutional logics (Couldry & Mejias, 2019). Within this framework, AI systems are understood not simply as computational tools but as socio-technical assemblages that reflect human

values, biases, and power hierarchies. AI-driven educational platforms such as adaptive learning systems, automated feedback tools, and predictive analytics depend on datasets that frequently overlook marginalised populations. Consequently, they risk embedding linguistic, cultural, and socio-economic biases that disproportionately disadvantage rural learners, particularly those who speak minoritised languages or come from low-income backgrounds (Benjamin, 2019; Noble, 2018).

Digital literacy fundamental skill for navigating digital environments also unevenly distributed across rural and urban settings. Research consistently shows that learners in rural communities possess lower levels of digital literacy due to limited exposure, inadequate training, and a lack of contextually appropriate digital content (Selwyn, 2016; van Dijk, 2020). These inequalities stem from structural conditions, including scarcity of digital devices, unreliable internet connectivity, and insufficient investment in rural educational infrastructures. Digital literacy itself is shaped by social contexts, including family background, school resources, teachers' digital competence, and community digital ecosystems. In regions where connectivity is intermittent and technological devices are shared or scarce, learners experience significant barriers in developing the digital skills necessary for academic engagement, civic participation, and future employability.

Furthermore, AI-enhanced educational tools often assume stable connectivity, proficiency in dominant languages, and familiarity with digital

interfaces. Such assumptions invisibilise the realities of rural learners whose linguistic repertoires, cultural knowledge systems, and educational experiences differ from those represented in AI training datasets. AI systems may fail to recognise rural accents or dialects, misinterpret cultural contexts, or deliver linguistically inaccessible content. These challenges highlight how technologies designed without meaningful engagement with marginalised communities risk reinforcing educational inequities under the guise of innovation (Benjamin, 2019).

Connectivity-the physical and infrastructural backbone of digital education-remains one of the most substantial barriers affecting rural learners. Many rural regions experience unstable electricity supply, limited broadband penetration, and prohibitively high data costs. These infrastructural deficits extend beyond students to include teachers, who often struggle to access digital resources for lesson planning, assessment, and professional development. In contrast, urban schools typically benefit from robust infrastructures, private investment, and greater institutional support for digital integration. Thus, the rural-urban connectivity divide becomes a key axis of educational inequality, influencing who can access digital tools, how frequently, and under what conditions.

Critical theory further deepens this analysis by interrogating how structural power shapes access to digital technologies. It challenges narratives that portray technological underdevelopment in rural areas as a matter of individual deficiency or community disinterest. Instead, critical

perspectives emphasise the political economy of technology controls digital infrastructures, whose knowledge is represented, and who benefits economically from digital expansion (Couldry & Mejias, 2019). These perspectives foreground the systemic marginalisation of rural and low-income communities within national and global digital development agendas.

This study situates these theoretical insights within a qualitative investigation of rural digital realities. Drawing on interviews with teachers, students, and community leaders, it examines how rural learners navigate digital literacy demands, how teachers interpret and respond to technological challenges, and how communities mobilise grassroots strategies to address digital exclusion. The research also explores how AI-driven educational systems-often implemented at national levels-interact with local linguistic practices, cultural identities, and pedagogical norms.

By foregrounding the concept of “digital equity by design,” the study argues that technological tools, infrastructures, and policies must be intentionally developed to account for diverse sociocultural contexts. This moves beyond simplistic narratives of digital inclusion that focus narrowly on device distribution or connectivity expansion. Instead, the argument highlights the need for culturally responsive, multilingual, and contextually grounded digital strategies that respect local epistemologies and empower rural learners.

In sum, the introduction establishes the conceptual foundation for understanding digital inequality as a sociological issue

intimately tied to power, identity, and access. It positions rural learners not as passive recipients of technological change but as stakeholders whose experiences and cultural contexts must shape the design and governance of educational technologies. Only by addressing these sociological dimensions can digital transformation contribute meaningfully to educational justice and the broader goals of inclusive and sustainable development.

METHODOLOGY

Research Design

This study employed a qualitative research design grounded in digital sociology and critical theory. Qualitative inquiry is well-suited for examining how individuals interpret and experience digital technologies in their everyday educational environments (Creswell & Creswell, 2018). A sociological lens allows attention to the structural conditions, cultural practices, and power relations that shape digital literacy and access. The research design integrates interviews, observations, and document analysis to build a rich, contextualised understanding of digital inequalities within rural educational settings.

Research Sites and Sampling

Data were collected in four rural communities characterised by limited digital infrastructure, low levels of ICT investment, and socioeconomic marginalisation. Schools were selected using purposive sampling to capture variations in connectivity, teacher training, and exposure to digital technologies. Participants included twenty students, ten teachers, and six community leaders.

Purposive sampling ensured representation across gender, age, linguistic background, and community digital engagement. This diversity facilitated a nuanced understanding of how digital exclusion manifests at different levels of the rural social ecosystem.

Data Collection

Data were collected through three complementary methods: semi-structured interviews, classroom observations, and document analysis. Semi-structured interviews enabled participants to articulate their experiences with digital tools, connectivity challenges, and AI-driven educational platforms in their own voices. Interviews ranged from 45 to 75 minutes and were conducted in participants' preferred languages, with translation assistance where necessary. Classroom observations provided insight into how teachers and students engaged with digital technologies during instructional activities. Observations focused on digital tool use, ICT integration in pedagogy, teacher–student interactions, and the presence or absence of digital materials. Document analysis included reviewing school ICT policies, government digital education guidelines, and platform usage reports. These documents allowed triangulation of interview and observation data by revealing institutional expectations and resource distributions.

Data Analysis

Data were analysed using thematic analysis, following the hybrid inductive–deductive approach outlined by Fereday and Muir-Cochrane (2006). Deductive codes were drawn from theoretical frameworks on

digital inequality, AI bias, and digital literacy. Inductive codes emerged from participant narratives, revealing unexpected patterns such as local innovation in community digital hubs and the emotional toll of digital exclusion. Coding was conducted using NVivo software, enabling systematic organisation of themes. Analysis proceeded through initial coding, identification of thematic categories, and iterative refinement of themes through cross-comparison of data sources. Reflexive memos were used throughout the analytic process to enhance transparency and interpretive rigour.

Ethical Considerations

Participants were informed of their rights, including confidentiality, voluntary participation, and the ability to withdraw from the study at any point. Pseudonyms were assigned to all participants. Special ethical attention was required when working with rural communities facing digital disadvantage, as discussions of technological access often intersect with feelings of shame, exclusion, or frustration. The research prioritised respectful engagement, cultural sensitivity, and recognition of local knowledge systems.

Researcher Positionality

The researcher maintained a reflexive stance throughout the study, acknowledging the power dynamics inherent in researching marginalised communities. Positionality memos documented the researcher's assumptions, interactions with participants, and perceived influence on the research process. Reflexive practice was essential to ensuring ethical engagement and minimising

outsider bias, particularly when interpreting community experiences with digital technology and AI.

FINDINGS

The analysis of interviews, classroom observations, and community documents revealed four overarching themes that explain how digital literacy, AI, and connectivity shape educational access in rural contexts: persistent digital divides rooted in infrastructural inequality, limited teacher readiness and uneven digital literacy, sociocultural and linguistic biases embedded in AI-driven platforms, and grassroots innovations and community-led strategies for digital inclusion. These themes collectively illustrate that digital inequality is not an incidental technological issue but a structural and sociological phenomenon embedded within broader systems of power, economic marginalisation, and cultural exclusion (Couldry & Mejias, 2019; Selwyn, 2016). The findings further reinforce the theoretical argument that digital transformation must be understood through the lens of critical digital sociology, recognising how technological design, resource allocation, and policy priorities reproduce inequalities across rural and urban educational landscapes (Lupton, 2015).

Infrastructural Disparities and Persistent Connectivity Gaps

Across all four research sites, participants identified infrastructural barriers-particularly unreliable internet access, inconsistent electricity supply, and limited device availability- as the most significant constraints shaping digital

education in rural schools. Students routinely reported being unable to complete digital assignments or access online educational platforms because connectivity dropped frequently during school hours. Teachers also noted that even basic tasks, such as downloading lesson resources or participating in online professional development, were difficult due to slow or unstable internet connections.

These findings reflect broader patterns documented in digital divide research, which show that geographical location remains a key predictor of digital exclusion (van Dijk, 2020). In rural contexts, infrastructural inequities compound existing socioeconomic disadvantages, limiting the extent to which schools and households can participate in national digital learning initiatives. For instance, during the COVID-19 pandemic, rural learners were disproportionately affected by school closures due to the absence of reliable digital alternatives, while urban learners were better positioned to access online lessons or AI-supported platforms (Creswell & Creswell, 2018).

Participants frequently expressed frustration that national digital education policies assume stable broadband access and device availability, assumptions that do not align with rural realities. Many rural students relied on shared devices at community centres or borrowed simple feature phones, hindering sustained engagement with digital tools. These infrastructural challenges underscore the structural nature of digital inequality and reinforce arguments from critical theorists that digital technology is

embedded within unequal political-economic systems (Couldry & Mejias, 2019).

Uneven Digital Literacy and Limited Teacher Preparedness

The findings indicate that digital literacy levels were uneven among rural students and significantly influenced by the digital competencies of their teachers. Many teachers expressed discomfort with integrating digital tools into their lessons due to insufficient training. Some had never received formal instruction in using AI-assisted learning systems, while others relied on ad hoc peer support or self-teaching. As Selwyn (2016) argues, digital literacy is not simply a technical skill but a social practice shaped by access, confidence, and institutional support.

Students' digital skills were directly correlated with teacher familiarity. In classrooms where teachers demonstrated greater confidence in using ICT, students were more engaged and familiar with digital tasks. Conversely, in classrooms led by less digitally skilled teachers, students showed minimal exposure to digital tools and experienced heightened anxiety when encountering online assignments or AI-supported applications. Teacher interviews revealed three main barriers to digital literacy development:

- Limited professional development opportunities due to distance from training centres.
- Absence of multilingual or locally relevant digital content, making digital tools harder to navigate.

- Unpredictable connectivity, which discouraged teachers from experimenting with online platforms.

These findings echo research by Wei et al. (2011), who note that digital adoption is strongly influenced by social-cognitive factors such as perceived self-efficacy and institutional support. Teachers described feeling inadequate or embarrassed when unable to troubleshoot digital problems, which sometimes led them to avoid digital integration altogether. The result is a cyclical pattern: limited teacher training reduces student exposure, which further inhibits school-wide digital capacity.

Sociocultural and Linguistic Biases in AI-Driven Educational Systems

A significant finding concerns the sociolinguistic and cultural biases embedded within AI-driven educational platforms. Students reported that voice-recognition features frequently misinterpreted local accents or dialects, leading to errors in pronunciation or comprehension assessments. Teachers noted that automated reading tools struggled to recognise rural speech patterns, often marking responses as incorrect even when students used appropriate vocabulary or completed tasks accurately. These issues align with critiques by Benjamin (2019) and Noble (2018), who argue that AI systems reproduce existing social inequalities because they are trained on datasets that reflect dominant linguistic and cultural norms.

Rural learners also reported feeling alienated when using AI platforms that presented content exclusively in dominant or

urban-centric languages. The lack of linguistic diversity reinforces feelings of exclusion and reduces students' confidence in engaging with digital tools. Teachers described situations in which students disengaged entirely from AI-supported tasks because the platform's language settings made the content inaccessible. This linguistic misalignment demonstrates how AI technologies risk amplifying epistemic injustice, where certain forms of knowledge or expression are systematically devalued (Noble, 2018).

Participants further expressed concerns that AI-based learning analytics classified rural learners as “slow,” “at-risk,” or “low-performing” based on patterns that did not account for connectivity issues, unfamiliar digital interfaces, or linguistic mismatches. Such classifications can have long-term implications for student motivation, self-identity, and academic tracking. These findings highlight the ethical imperative of developing AI systems that are culturally and linguistically inclusive, an argument strongly supported in the critical AI ethics literature (Benjamin, 2019).

Community-Based Digital Initiatives and Local Innovation

Despite significant challenges, the findings reveal substantial local ingenuity in addressing digital exclusion. Community leaders, parents, and teachers described various grassroots initiatives that helped mitigate infrastructural and educational barriers. These include:

- Community digital hubs, often housed in libraries or local offices,

where students could access shared computers during evenings or weekends.

- Locally developed offline learning materials, including downloadable modules and multimedia content stored on USB drives, which were distributed to households without internet access.
- Volunteer-led digital literacy workshops that helped younger learners navigate basic ICT functions.
- Partnerships with local NGOs, which provided refurbished devices and solar-powered charging stations.

These initiatives demonstrate that while rural communities face structural barriers, they are not passive recipients of digital inequality. Instead, they actively participate in shaping local digital ecosystems, reinforcing the argument that sustainable digital transformation must involve community empowerment and bottom-up engagement (Lupton, 2015). Teachers emphasised that although these solutions were helpful, they could not fully replace systemic support from government agencies. Nonetheless, the presence of community innovations highlights important avenues for policy design that centre rural agency and local epistemologies.

Policy Gaps and Misalignment with Rural Realities

Participants consistently argued that national policies emphasise digital transformation but rarely engage rural stakeholders in decision-making. Schools received directives to integrate AI-supported platforms without additional funding,

training, or infrastructural support. Teachers expressed frustration that policies often assumed a baseline level of digital readiness that rural communities did not possess. As a result, policies became burdensome rather than supportive.

Many educators felt that national curricula, digital content, and AI algorithms reflected urban learning environments and dominant cultural norms. Little consideration was given to rural linguistic diversity, local knowledge systems, or indigenous epistemologies. This policy–reality mismatch supports the critical theory argument that digital expansion often reflects centralised priorities that overlook marginalised communities (Couldry & Mejias, 2019).

Participants recommended several policy reforms, including subsidising rural internet costs, providing dedicated digital literacy training, and creating multilingual digital content aligned with local contexts. Their suggestions reinforce global research advocating for equitable and culturally responsive digital policies (van Dijk, 2020).

Overall, the findings reveal that digital inequality in rural education is shaped by interconnected socioeconomic, cultural, and technological factors. Infrastructural limitations, uneven digital literacy, AI biases, and inadequate policy support collectively produce systemic barriers that limit rural learners' participation in digital education. However, community-led innovations demonstrate resilience and offer pathways for more inclusive digital futures. These findings underscore the need for policy frameworks that prioritise digital equity by design

approaches that intentionally address rural learners' linguistic, cultural, and infrastructural realities.

DISCUSSION

The findings of this study demonstrate that digital literacy, AI integration, and rural connectivity challenges intersect to produce layered and systemic inequities in educational access for rural learners. This discussion critically examines these findings through the lens of digital sociology and critical theory, situating them within broader scholarly debates on technology, power, and social inequality. The analysis reinforces the argument that digital exclusion is not merely a technological problem but a sociological one, shaped by structural disparities, policy failures, and cultural biases embedded in digital and AI systems (Benjamin, 2019; Couldry & Mejias, 2019; Selwyn, 2016). By examining how digital infrastructures, teacher capacities, AI-driven systems, and community initiatives intersect, this section deepens the theoretical understanding of digital inequality and offers pathways for more equitable educational futures.

Rethinking Digital Inequality: Beyond the Access Paradigm

Traditional discourse on digital inequality often focuses on access, whether individuals possess devices or internet connections. While access remains essential, this framework is insufficient for capturing the complex sociological processes that shape digital exclusion in rural contexts. The findings reinforce van Dijk's (2020) argument that the digital divide comprises

four layers: motivational, material, skills-related, and usage inequalities. Rural learners face deficits across all layers: limited motivation due to negative experiences, inadequate access to devices, low levels of digital literacy, and reduced opportunities for meaningful digital engagement.

The persistence of infrastructural inequities, such as unstable internet connectivity and unreliable electricity, illustrates structural barriers that individuals cannot overcome independently. These are systemic issues aligned with broader socioeconomic marginalisation patterns. Thus, the findings support critical perspectives that argue digital technologies are embedded within political economies that prioritise urban growth and profit-driven technological expansion over equitable development (Couldry & Mejias, 2019). The fact that rural communities bear the brunt of infrastructural neglect reveals how national digital development agendas often reproduce rather than challenge spatial inequalities.

Moreover, even when access is present, such as temporary connectivity or shared devices, learners face challenges in effectively using digital tools due to linguistic mismatches, unfamiliar interfaces, or AI systems that misinterpret local speech. These findings underscore that the concept of "access" must be reconceptualised to include quality, reliability, linguistic alignment, and the broader sociocultural context in which technology is used.

Digital Literacy as a Social Practice Shaped by Inequality

Digital literacy is not simply the ability to operate devices but a complex social practice influenced by cultural norms, institutional support, and social networks (Selwyn, 2016). In the rural schools studied, digital literacy development was hindered not only by infrastructural barriers but also by the limited digital readiness of teachers. These findings align with Wei et al.'s (2011) social cognitive model of digital adoption, which highlights that individuals' digital engagement is shaped by perceived self-efficacy, social support, and contextual opportunities.

Teachers' lack of confidence and limited training reduced their willingness to integrate digital tools, thereby constraining students' digital learning experiences. This raises critical questions about how teacher professional development is conceptualised in national digital transformation agendas. Policies often assume that teachers possess digital competencies or that one-off workshops are sufficient. However, as the findings demonstrate, digital literacy requires sustained, context-specific training, supported by reliable infrastructure and culturally relevant digital materials.

Furthermore, the findings suggest that digital literacy development is mediated by broader sociocultural dynamics. Many rural students experienced anxiety when interacting with AI-driven platforms that did not recognise their linguistic expressions or that consistently marked their responses as incorrect. Over time, this can erode learners' confidence and reinforce educational inequalities. This phenomenon reflects Bourdieu's concept of "symbolic violence,"

where institutional structures legitimise certain linguistic and cultural forms while devaluing others (Bourdieu, 1991). In the digital sphere, this symbolic violence is enacted through AI systems that privilege dominant languages and cultural norms, rendering rural linguistic identities invisible.

Therefore, the discussion highlights that digital literacy cannot be disentangled from issues of identity, recognition, and cultural legitimacy. It must be approached as a relational and context-dependent practice, requiring digital tools and pedagogies that affirm rural learners' languages, cultures, and ways of knowing.

AI Bias and Epistemic Injustice in a Rural Context

One of the most significant findings of this study concerns the linguistic and cultural biases embedded in AI-driven educational platforms. These biases manifest through misrecognition of rural accents, inaccurate assessment of student performance, and the exclusive use of dominant languages in digital content. These outcomes are neither accidental nor neutral. Instead, they reflect what Benjamin (2019) calls the "New Jim Code"—how technological systems encode racial, linguistic, and cultural biases under the guise of objectivity.

Noble's (2018) concept of "algorithms of oppression" further illuminates how AI systems, trained on datasets that reflect dominant social groups, systematically marginalise those who do not fit these patterns. When rural students are labelled as low-performing due to algorithmic misinterpretation or

connectivity-related disruptions, AI technologies reinforce deficit perspectives that pathologise marginalised learners. This constitutes a form of epistemic injustice, whereby certain groups' knowledge, language, or cultural expressions are devalued or rendered illegible (Fricker, 2007).

The sociolinguistic dimension of AI bias is particularly salient in rural contexts. AI platforms used in the studied schools were designed with urban language norms in mind. As a result, rural speech varieties—often shaped by minoritised languages or dialects—were not recognised. This not only disrupts learning but also implicitly communicates that rural linguistic repertoires are inferior. Such messages contribute to linguistic self-stigma and alienation, reinforcing social hierarchies that privilege urban, dominant-language speakers.

The discussion raises critical questions about the ethical deployment of AI in education. If AI tools reproduce existing inequalities, their uncritical implementation risks exacerbating rather than alleviating educational disparities. These findings corroborate global debates on AI ethics, which emphasise the need for inclusive datasets, transparent algorithmic governance, and participatory design processes that involve marginalised communities (Couldry & Mejias, 2019; Benjamin, 2019).

Community Innovations: Resilience and Collective Agency

Despite structural barriers, rural communities demonstrated remarkable creativity and resilience in responding to

digital exclusion. These findings align with Lupton's (2015) assertion that digital practices are negotiated, shaped, and transformed through everyday social interactions and collective agency. The emergence of community digital hubs, locally adapted offline materials, and volunteer-led digital literacy workshops illustrates how rural actors reconfigure available resources to expand learning opportunities.

These grassroots initiatives highlight several important insights. First, rural communities are not passive victims of digital inequality; they actively mobilise social networks, local knowledge, and community solidarity to address educational challenges. Second, community-driven solutions often align more closely with local cultural and linguistic contexts than national digital platforms. For example, offline learning modules created by teachers included locally relevant examples, indigenous knowledge, and multilingual explanations, elements absent from standardised AI-driven content.

Third, community innovations underscore the potential for “digital inclusion from below,” where bottom-up strategies complement or compensate for top-down policy deficits. This resonates with arguments in digital sociology that emphasise the importance of local agency in shaping technological adoption and adaptation (Lupton, 2015). Recognising and scaling such community-led practices could form a crucial component of national digital equity strategies.

However, while these initiatives mitigate inequalities, they cannot replace structural reforms. Community-led solutions are often fragile, dependent on volunteer labour, and constrained by limited resources. Thus, sustainable digital inclusion requires stronger institutional support that builds upon, not replaces, community innovations.

Digital Policy Gaps: The Rural–Urban Disconnect

A recurring theme across the findings is the misalignment between national digital education policies and rural realities. Policies frequently assume urban conditions: stable connectivity, high device availability, teacher digital readiness, and alignment of AI systems with dominant language norms. This assumption reflects what Couldry and Mejias (2019) describe as “data colonialism”—the imposition of centralised technological systems that overlook local contexts and reproduce existing hierarchies.

Teachers expressed frustration with policy directives that mandated the use of AI-driven tools without providing funding, training, or troubleshooting support. This creates what Selwyn (2016) refers to as “policy fantasy”—where national digital transformation narratives ignore the material constraints of everyday schooling. As a result, rural schools face pressure to comply with unrealistic expectations, reinforcing institutional inequities.

Furthermore, the absence of rural representation in policy design leads to frameworks that marginalise rural linguistic and cultural diversity. Digital content, training programs, and AI systems are

designed around urban language norms and pedagogical assumptions. This centralisation contributes to educational homogenisation, eroding local knowledge systems and exacerbating cultural alienation among rural learners.

The discussion thus highlights the need for participatory policy-making that involves rural teachers, students, and community leaders. Policy frameworks must be grounded in local epistemologies, multilingual realities, and context-specific challenges. Without such involvement, digital education initiatives risk perpetuating the rural–urban divide rather than bridging it.

Towards Digital Equity by Design: A Critical Framework

Drawing together the findings and theoretical perspectives, this section proposes “digital equity by design” as a guiding framework for inclusive educational technology development. This concept emphasises intentional, proactive efforts to integrate equity considerations into the design, implementation, and evaluation of digital tools and policies. It aligns with critical digital sociology’s call to interrogate power structures embedded in technological systems (Lupton, 2015) and with AI ethics frameworks advocating for fairness, transparency, and community participation (Benjamin, 2019). Digital equity by design involves the following principles:

AI platforms and digital content must reflect the linguistic diversity, cultural identities, and epistemological traditions of rural communities. Multilingual interfaces, dialect recognition capabilities, and content

co-created with local educators can help address epistemic injustice and enhance learner engagement (Noble, 2018).

Connectivity, electricity, and device access should be treated not as market commodities but as essential components of educational infrastructure. Public–private partnerships must prioritise rural regions and adopt inclusive pricing models to ensure universal access (van Dijk, 2020).

Teacher digital literacy training must be ongoing, locally relevant, and integrated into professional practice. Teachers should not be positioned as “implementers” of external technologies but as co-designers who shape pedagogical uses of digital tools (Selwyn, 2016).

Rural communities must be recognised as critical stakeholders in digital transformation. Incorporating their knowledge, priorities, and innovations can inform more sustainable and context-sensitive digital strategies (Lupton, 2015).

AI deployment in schools must include transparency mechanisms, bias audits, and clear safeguards against algorithmic discrimination. Such measures are essential for preventing the reproduction of structural inequalities through digital means (Benjamin, 2019).

This critical framework underscores that digital inclusion is not a natural outcome of technological adoption. It requires deliberate sociopolitical action that centres equity, cultural recognition, and the lived experiences of marginalised communities.

Implications for Theory, Policy, and Practice

The theoretical contribution of this study lies in its integration of digital sociology, critical theory, and educational inequality research to conceptualise digital exclusion as a multi-layered sociological phenomenon. It challenges simplistic narratives that depict rural learners as technologically backward or disinterested. Instead, it positions digital inequality within broader structures of power, resource distribution, and cultural hegemony.

Policy implications include the urgent need to reform national digital strategies to align with rural realities. This requires expanding infrastructure investment, adopting inclusive linguistic policies, designing AI systems that accommodate rural speech varieties, and shifting from technocratic decision-making to participatory governance.

For educators and practitioners, the findings highlight the importance of context-responsive pedagogy, teacher agency, and community collaboration. Digital literacy must be approached as a culturally embedded practice, and teachers need robust institutional support to navigate technological challenges.

The discussion demonstrates that digital inequality in rural education is produced at the intersection of technological, sociocultural, and policy-related factors. The structural nature of these inequalities underscores the necessity of rethinking digital transformation through a lens of justice, inclusion, and cultural diversity.

Digital equity by design offers a pathway for conceptualising and implementing more equitable digital futures-futures that recognise rural learners as active participants whose linguistic identities, cultural knowledge, and community innovations are essential to the digital education landscape.

CONCLUSION

The findings of this study affirm that digital transformation in education holds transformative potential but also risks widening existing social inequalities when rural realities and sociolinguistic diversities are not taken into account. Rural learners face intersecting challenges, including unreliable connectivity, limited access to digital devices, insufficient teacher training, and AI-driven platforms that privilege dominant linguistic and cultural norms. These systemic inequalities reveal that digital exclusion is not simply a matter of infrastructural absence but a structural issue embedded in deeper sociological forces, including class, geography, language, and power.

One of the central conclusions of this research is that technological innovation alone cannot solve educational inequality. The integration of AI and digital learning tools must be guided by principles of social justice and cultural responsiveness. AI systems used in education must be scrutinised for biases and designed with diverse datasets that genuinely reflect the linguistic, cultural, and socio-economic realities of rural communities. Without such intentionality, AI risks reinforcing the very inequities it aims to reduce.

The study also underscores the importance of community-based solutions that emerge from local knowledge and grassroots mobilisation. Community digital hubs, offline learning technologies, locally curated e-learning materials, and multilingual resources demonstrate that innovation does not solely originate in urban or technologically advanced spaces. These community-driven initiatives offer scalable models that can inform national and international strategies for bridging the digital divide.

Policy implications from this research are clear: governments must prioritise affordable connectivity, invest in teacher training for digital pedagogy, and align digital education policies with rural socio-linguistic contexts. Sustainable change requires multi-stakeholder collaboration between governments, educators, technologists, local communities, and global organisations. Supporting rural learners is not only a matter of technological inclusion but also an investment in social equity, cultural preservation, and long-term educational resilience.

Ultimately, the study contributes to the broader field of digital sociology by advancing the concept of “digital equity by design.” It calls for an educational future in which technology is not merely adopted, but critically shaped, reformed, and contested to ensure that digital transformation supports rather than harms marginalised communities. By recognising the interplay between AI ethics, rural education, and sociological inequalities, the research provides a pathway

toward more inclusive, ethical, and equitable digital futures.

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Conflicts of Interest

The author declares no conflicts of interest.

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