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Learning Without a Signal: Digital Justice in Technology-Based Education Policy Implementation in East Sumba

David Marthinus Wulla*
Universitas Kristen Wira Wacana, Waingapu, Sumba Timur, Indonesia
davidwulla@gmail.com

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*Corresponding Author

Abstract

Digital transformation has become an important component of contemporary education policy, yet its benefits are unevenly distributed across regions. In remote areas, limited internet connectivity, electricity, digital devices, and teacher capacity can prevent students from fully participating in technology-based learning. This study investigates digital justice in the implementation of technology-oriented education policy in East Sumba, East Nusa Tenggara. It examines how infrastructural and socioeconomic inequalities shape students' and teachers' ability to benefit from digital education initiatives. Using a qualitative case study approach, the research draws on policy documents and perspectives from teachers, students, school leaders, parents, and local policymakers. Digital justice is conceptualized as more than equal access to devices; it encompasses meaningful connectivity, digital competence, quality of content, and the capacity to use technology for educational participation. The study argues that national digitalization policies may unintentionally reproduce educational inequality when implementation assumes infrastructure and digital readiness that are not equally available across territories. The research therefore advocates a differentiated policy approach in which digital transformation is accompanied by investments in connectivity, electricity, teacher capacity, offline learning alternatives, and community-based digital support. The study contributes to debates on digital education policy by foregrounding territorial inequality within national digital transformation agendas.

[*Transformasi digital telah menjadi komponen penting dari kebijakan pendidikan kontemporer, namun manfaatnya tidak terdistribusi secara merata di berbagai wilayah. Di daerah terpencil, konektivitas internet, listrik, perangkat digital, dan kapasitas guru yang terbatas dapat menghambat partisipasi siswa secara penuh dalam pembelajaran berbasis teknologi. Studi ini meneliti keadilan digital dalam implementasi kebijakan pendidikan berorientasi teknologi di Sumba Timur, Nusa Tenggara Timur. Studi ini mengkaji bagaimana ketidaksetaraan infrastruktur dan sosial ekonomi membentuk kemampuan siswa dan guru untuk memperoleh manfaat dari*

inisiatif pendidikan digital. Dengan menggunakan pendekatan studi kasus kualitatif, penelitian ini mengacu pada dokumen kebijakan dan perspektif dari guru, siswa, kepala sekolah, orang tua, dan pembuat kebijakan lokal. Keadilan digital dikonseptualisasikan sebagai lebih dari sekadar akses yang sama terhadap perangkat; hal ini mencakup konektivitas yang bermakna, kompetensi digital, kualitas konten, dan kapasitas untuk menggunakan teknologi untuk partisipasi pendidikan. Studi ini berpendapat bahwa kebijakan digitalisasi nasional dapat secara tidak sengaja mereproduksi ketidaksetaraan pendidikan ketika implementasinya mengasumsikan infrastruktur dan kesiapan digital yang tidak tersedia secara merata di seluruh wilayah. Oleh karena itu, penelitian ini menganjurkan pendekatan kebijakan yang berbeda di mana transformasi digital disertai dengan investasi dalam konektivitas, listrik, kapasitas guru, alternatif pembelajaran offline, dan dukungan digital berbasis komunitas. Studi ini berkontribusi pada perdebatan tentang kebijakan pendidikan digital dengan menyoroti ketidaksetaraan teritorial dalam agenda transformasi digital nasional.]

Keywords: digital justice, digital divide, education technology, rural education, East Sumba

Introduction

Digital technology has become deeply embedded in contemporary education policy. Governments increasingly promote digital platforms, electronic learning resources, online assessment, digital administration, and technology-mediated pedagogies as instruments for improving educational quality and expanding access. The policy appeal is understandable. Digital technologies can potentially overcome geographical barriers, expand access to learning materials, connect teachers and students, personalize learning, and reduce some of the costs associated with conventional educational delivery. Nevertheless, the assumption that digitalization automatically produces educational improvement is increasingly questioned. The 2023 UNESCO Global Education Monitoring Report emphasizes that the effects of educational technology vary according to socioeconomic conditions, teacher preparedness, infrastructure, and the characteristics of the technology itself. Technology can support disadvantaged learners, but the most disadvantaged may also be the least able to benefit from it (UNESCO 2023).

The problem is particularly important in geographically disadvantaged regions. In such contexts, digital education is not implemented on a technologically neutral terrain. Students may have different levels of access to electricity, smartphones, computers, internet connections, learning platforms, and adult assistance. Schools may differ in their network connectivity, equipment, technical support, and teacher capacity. These differences mean that a policy requiring

students to access the same online platform does not necessarily provide them with the same educational opportunity. The central issue is therefore not whether a digital learning system is formally available, but whether students can use it effectively and continuously for educational purposes. This distinction is consistent with emerging scholarship that conceptualizes the digital divide as multidimensional, encompassing not only access to devices but also differences in usage, skills, support, and educational outcomes (van Deursen and van Dijk 2014; Warschauer 2004; Martin, Ceviker, and Gezerc 2024).

East Sumba provides an important case through which this problem can be examined. Located in East Nusa Tenggara, the regency combines geographically dispersed settlements, rural communities, and varying levels of infrastructure and public-service accessibility. The *Sumba Timur Regency in Figures 2024* provides comprehensive official statistics on the geographic, socioeconomic, and infrastructural conditions of the regency and therefore offers an important empirical basis for understanding the environment in which education policy is implemented (BPS Kabupaten Sumba Timur 2024). The regional context is particularly relevant to digital justice because technological learning requires a chain of complementary conditions: electricity, connectivity, devices, content, teacher competence, student competence, and institutional support. Weakness in any one of these components can undermine the effectiveness of the entire system.

The infrastructural problem is not limited to internet access. Electricity constitutes a fundamental prerequisite for digital education, yet electricity availability remains uneven in East Nusa Tenggara. Regional planning documents indicate that although electrification has improved, substantial differences remain between districts and household groups. In Sumba Timur, the percentage of households using PLN electricity with meters increased substantially between 2020 and 2022, but the same official data also show the continuing presence of households relying on non-PLN or non-electric sources (Government of East Nusa Tenggara 2023). This matters because digital education policy frequently assumes electricity as an invisible infrastructure. A student cannot benefit from a digital learning platform if a device cannot be reliably charged, regardless of whether the platform itself is freely available.

The digital divide is therefore closely connected to broader socioeconomic inequality. Research on technology access consistently demonstrates that household income, parental education, geographical location, and digital skills shape the ability to benefit from digital technologies (Hargittai 2010; van Deursen and van Dijk 2014; Robinson et al. 2015). Digital exclusion is consequently not simply a technological problem. It is a social and educational problem because existing inequalities in economic and cultural resources can be reproduced through unequal technological participation. Bourdieu's concept of capital is particularly useful in this respect: households possess different forms of economic, cultural, and social capital that influence how effectively they can convert technological resources into educational advantages (Bourdieu 1986).

The COVID-19 pandemic made these inequalities particularly visible. When schools shifted rapidly toward online and remote learning, access to devices and internet connectivity became prerequisites for educational participation. In Indonesia, research documented substantial challenges among rural teachers and students, including unstable connectivity, limited student-owned devices, and difficulties maintaining student engagement (Kusuma 2020). Similar research found that rural schools experienced considerably greater constraints in implementing fully online learning than their urban counterparts (Setiawan and Iasha 2020). The pandemic therefore demonstrated that "online learning" is not a single educational intervention but a complex institutional arrangement dependent on infrastructure, teacher preparedness, household resources, and students' capacity to participate.

Importantly, East Sumba itself provides empirical evidence that alternative models can emerge when full online learning is unrealistic. Nahumury and Antony (2022) examined semi-online learning at SMK Negeri A Waingapu in East Sumba and a school in Merauke, finding that semi-online arrangements were adopted to maintain learning in environments characterized by limited digital access. This finding is significant because it challenges the assumption that educational digitalization must necessarily take the form of continuous internet-based learning. Where connectivity is unreliable, hybrid, semi-online, offline-first, radio-supported, or downloadable-content models may be more equitable than a policy that requires continuous broadband access.

The central research problem of this article is therefore the tension between universal digital education policy and territorially unequal implementation conditions. National policy may establish equal expectations for schools, but implementation takes place in territories characterized by unequal infrastructure and institutional capacity. This creates a form of policy paradox: a policy designed to democratize educational access may reproduce inequality when it distributes the same technological requirements to communities with very different capacities to meet them. This article asks on how does territorial and socioeconomic inequality shape the implementation of technology-based education policy in East Sumba, and what would a digitally just implementation framework require? The article argues that digital justice cannot be achieved through equal distribution of devices or platforms alone. It requires differentiated institutional support that recognizes unequal starting conditions. The appropriate policy objective is therefore not technological uniformity but substantive equality in students' capability to use technology for meaningful learning.

The first strand of previous research conceptualizes the digital divide as a multidimensional form of inequality. Early research often treated the divide primarily as a difference between those who possessed internet access and those who did not. However, subsequent scholarship demonstrated that access alone cannot explain differences in technological benefits. Warschauer (2004) argued that meaningful digital inclusion depends on physical resources, digital skills, social support, and institutional structures. Hargittai (2002) similarly demonstrated that

internet users possess different levels of digital literacy and skill, meaning that simple measures of connectivity can conceal significant inequalities. van Dijk (2005) further conceptualized digital inequality as a cumulative process involving motivational, material, skills, and usage divides. This literature is particularly relevant to East Sumba because the educational consequences of weak connectivity cannot be separated from differences in device availability, digital competence, and social support.

The second strand examines the relationship between digital technology and educational inequality. Robinson et al. (2015) argue that digital inequality reflects and interacts with existing social inequalities rather than operating independently from them. Selwyn (2016) similarly warns against treating technology as a neutral instrument detached from questions of power and social structure. In education, this means that technological innovations can produce benefits for students who already possess the resources required to use them effectively while producing limited benefits for those with fewer resources. Recent systematic research reinforces this argument. Martin, Ceviker, and Gezerc (2024), reviewing 77 studies across two decades, identified socioeconomic status, geography, parental education, school type, and digital skills as important dimensions of the educational digital divide. The third strand focuses specifically on technology integration in rural schools. Rural schools often face a combination of infrastructural, geographic, institutional, and professional constraints. Mustafa, Nguyen, and Gao (2024), in a systematic review, identified twenty-nine challenges associated with technology integration in rural schools and emphasized that digital inequality is closely related to broader educational inequality. Research in developing countries similarly suggests that technology-supported education is more likely to produce meaningful effects when it is accompanied by teacher development, context-sensitive design, community engagement, and pedagogical integration rather than simple technology provision (Norman 2023).

The fourth strand concerns teachers. Technology-based educational reform frequently assumes that teachers will be able to integrate new platforms and digital resources into instruction. Yet technology adoption depends on teacher confidence, knowledge, pedagogical beliefs, infrastructure, and institutional support. Buabeng-Andoh (2012) identified teacher-related and institutional factors as significant influences on ICT adoption. More recent evidence from low- and middle-income countries indicates that technology-mediated professional development can provide valuable opportunities for teacher learning but that human support and locally appropriate forms of professional interaction remain essential (Drossel et al. 2022). The implication is that digital transformation cannot be separated from teacher development.

A fifth strand examines the Indonesian context. Research conducted during and after the COVID-19 pandemic documented the difficulties experienced by Indonesian schools when digital learning became necessary. Rural teachers reported challenges involving internet connectivity, student devices, student

engagement, and digital learning practices (Kusuma 2020). Setiawan and Iasha (2020) similarly found that rural online learning depended heavily on relatively simple communication technologies such as WhatsApp because more sophisticated forms of digital learning were difficult to sustain. The East Sumba-specific study by Nahumury and Antony (2022) is especially important because it demonstrates that semi-online learning can constitute a pragmatic response to connectivity constraints rather than merely a temporary compromise.

Taken together, these studies establish that digital access is multidimensional, that technology can reproduce social inequality, and that rural implementation requires contextual adaptation. However, an important analytical gap remains. Much of the Indonesian literature treats digital inequality either as an infrastructure problem or as a pedagogical problem. Less attention has been given to digital inequality as a matter of policy justice, in which uniform national requirements encounter territorially differentiated implementation capacities. This article addresses that gap by conceptualizing East Sumba not simply as a "low-connectivity" location but as a policy environment in which equal digital requirements can generate unequal educational opportunities.

This study uses a qualitative descriptive-analytic case-study design. The case is East Sumba Regency, East Nusa Tenggara, selected because its geographic and infrastructural conditions provide a relevant context for examining the implementation of technology-based education policy in a rural and geographically dispersed setting. The analysis relies on documentary evidence rather than claiming to report primary interview findings. Sources include official statistical publications from Statistics Indonesia, government education databases, regional development documents, Indonesian laws and regulations, international education reports, and peer-reviewed research concerning digital inequality, rural education, teacher technology adoption, and educational technology. The analytical process involved three stages. First, policy documents and statistical sources were examined to identify the infrastructural and institutional conditions that shape digital education implementation. Second, the scholarly literature was synthesized thematically around access, meaningful connectivity, digital competence, teacher capacity, and alternative learning modalities. Third, these findings were interpreted through a digital-justice framework. Digital justice in this study consists of five dimensions: physical access, meaningful connectivity, digital capability, educational usefulness, and institutional responsiveness. This approach follows the broader literature showing that digital inclusion involves more than merely possessing an internet connection or digital device (Warschauer 2004; van Dijk 2005; Martin, Ceviker, and Gezerc 2024). The purpose is not to measure individual students' internet use statistically but to explain how policy design and territorial conditions interact to create unequal educational capabilities.

From Digital Access to Digital Justice

The most fundamental analytical mistake in technology-based education policy is to equate access with justice. A student who technically possesses access to an online learning platform is not necessarily in the same educational position as a student with stable broadband, a personal laptop, uninterrupted electricity, and parents capable of providing technical and academic assistance. Digital access is therefore better understood as a continuum than as a binary condition.

The distinction is especially important in East Sumba. Official statistical publications provide extensive information about socioeconomic and infrastructural conditions in the regency, while education databases demonstrate that individual schools can have different levels of internet and electricity access. The existence of an internet-access field in school-level administrative data is itself insufficient to determine whether the connection is fast, stable, affordable, or pedagogically useful. A school may technically be connected while teachers and students still experience interruptions that make synchronous online learning impractical.

This distinction corresponds to the concept of meaningful connectivity. Meaningful connectivity requires more than a signal; it involves adequate speed, reliability, appropriate devices, affordability, and the ability to use connectivity regularly for productive purposes. In education, meaningful connectivity must additionally be assessed in relation to learning requirements. A connection sufficient for text messaging may be inadequate for video conferencing or downloading large learning materials. A smartphone may be sufficient for communicating through WhatsApp but insufficient for complex assignments, coding, document editing, or online examinations.

The policy consequence is significant. If digital education programs define success through the number of schools connected, devices distributed, or accounts created, they may report impressive implementation results without demonstrating educational improvement. UNESCO's 2023 GEM Report explicitly cautions against evaluating technology through adoption alone and emphasizes the need to assess whether technology is appropriate, equitable, evidence-based, and sustainable. Digital justice therefore requires changing the policy question from "Does the school have internet?" to "Can students reliably use appropriate digital resources to participate in meaningful learning?" The second question is considerably more demanding, but it is also closer to the substantive educational objective.

Territorial Inequality and the Infrastructure Chain

Digital education depends on an infrastructure chain rather than a single technological input. Electricity, telecommunications networks, devices, platforms, technical support, and digital content must operate together. Failure at any point can undermine the educational value of the others. Electricity is an especially

important but frequently overlooked element. Regional development documentation for East Nusa Tenggara indicates that electrification has expanded but remains uneven across households and regions. For Sumba Timur, official figures show improvement in PLN electricity access between 2020 and 2022, but also indicate continued reliance on non-PLN and non-electric sources among a portion of households. This has direct educational consequences. A student cannot participate consistently in digital learning if devices cannot be charged reliably or if electricity interruptions coincide with scheduled learning activities.

Connectivity creates a second layer of inequality. Rural and geographically dispersed communities frequently face higher infrastructure costs because the population density is lower and physical distances between settlements are greater. As a result, commercial incentives alone may not be sufficient to generate connectivity equivalent to that available in urban centers. The digital divide therefore becomes partly a problem of public infrastructure and territorial planning.

The same principle applies to schools. A national digital education program may distribute devices to schools without adequately considering whether local network infrastructure can support them. This produces what may be called technological stranded capacity: hardware exists, but the surrounding infrastructure is insufficient to make it educationally productive. The evidence from East Sumba is particularly instructive because local educational actors have already experimented with semi-online arrangements in response to limited digital infrastructure. Nahumury and Antony (2022) documented semi-online learning practices at SMK Negeri A Waingapu, demonstrating that schools can combine online and offline methods to sustain educational delivery where full online access is unrealistic. Such adaptation should not be viewed merely as an emergency response. It can become a legitimate component of a differentiated digital policy.

Household Inequality and the Privatization of Digital Learning Costs

Digital education can unintentionally shift educational costs from the state to households. When schools rely on students' personal smartphones, household internet subscriptions, electricity, and private technical support, families effectively subsidize public education. This transfer is particularly problematic because household capacity is unequal. Higher-income families may possess multiple devices, faster connections, quiet learning spaces, and parents with sufficient digital and educational knowledge to assist their children. Poorer households may depend on a single smartphone shared among several family members. Even where internet access is available, the cost of data can constrain the amount of educational material that students can download or stream.

The resulting inequality is not simply an economic problem. It becomes an educational problem because the same assignment generates different costs for different students. A video-based assignment may be inexpensive for an urban student with unlimited home broadband but expensive for a rural student

dependent on mobile data. A requirement to submit a digitally formatted document may be straightforward for a student with a laptop but difficult for one who relies exclusively on a smartphone.

Bourdieu's framework helps explain this process. Digital technology becomes educationally valuable only when students possess the forms of economic, cultural, and social capital necessary to convert it into learning. A device is therefore not an educational benefit in isolation. Its value depends on the resources surrounding it.

This argument is consistent with international research showing that digital inequality reflects existing socioeconomic inequality. Robinson et al. (2015) emphasize that digital inequalities are embedded within broader patterns of social inequality, while Hargittai (2010) demonstrates that users differ significantly in their digital skills even when they possess nominal access. The policy implication is that device distribution should not be the endpoint of digital inclusion. Public education policy must consider data affordability, household electricity, shared-device arrangements, accessibility, technical assistance, and the learning environment at home. Otherwise, digitalization may increase the private costs of education precisely for families least able to bear them.

Teachers as the Missing Infrastructure of Digital Transformation

Technology-based education policies frequently emphasize devices and platforms while underestimating teachers. Yet teachers are the principal mediators between technology and pedagogy. A digital platform does not teach by itself. Teachers determine how technology is integrated into curriculum, how students interact with digital resources, how learning progress is monitored, and how technological limitations are accommodated.

Research on ICT adoption has consistently identified teacher competence and attitudes as important determinants of technology integration. Buabeng-Andoh (2012) found that teacher-level factors, organizational support, and technological conditions influence ICT adoption. Ertmer and Ottenbreit-Leftwich (2010) similarly argued that successful technology integration requires not only technical knowledge but also pedagogical beliefs, confidence, and institutional conditions.

The problem is more complex in remote schools. Teachers working in geographically isolated areas may have fewer opportunities to participate in face-to-face professional development. They may also experience weaker professional networks and limited access to technical assistance. Drossel et al. (2022), reviewing technology-mediated teacher professional development across low- and middle-income countries, found that technology can expand professional learning opportunities but that human relationships, facilitation, and contextualization remain essential. This means that teacher training cannot simply consist of short workshops on how to operate a platform. Teachers need sustained support in instructional design, digital assessment, classroom management in blended environments, content creation, digital safety, and strategies for low-bandwidth

teaching. In East Sumba, training should additionally address the reality that teachers may need to switch between online and offline modalities depending on network conditions. The distinction between technical competence and pedagogical digital competence is important. A teacher may know how to upload materials to a learning management system without knowing how to design an effective digital lesson. Conversely, a teacher may possess strong pedagogical skills but lack the infrastructure needed to implement them. Digital justice therefore requires simultaneous investment in human capability and technological infrastructure.

Why One-Size-Fits-All Digital Policy Fails

A uniform policy model is administratively attractive because it simplifies standards, procurement, monitoring, and evaluation. However, administrative uniformity can generate substantive inequality when implementation conditions differ dramatically between territories. Consider a policy requiring all students to access online materials every week. In a well-connected urban school, this may be a reasonable expectation. In a remote East Sumba community where connectivity is intermittent, the same requirement creates an additional burden. Students may need to travel to locations with stronger signals, spend money on mobile data, or wait until network availability improves. The formal rule is equal, but the practical cost is unequal.

This is a classic distinction between formal equality and substantive equality. Formal equality treats all schools and students according to the same standard. Substantive equality recognizes that individuals and communities may require different forms of support to reach comparable outcomes.

The literature on rural technology integration strongly supports contextual adaptation. Mustafa, Nguyen, and Gao (2024) identify infrastructure, technical support, teacher capacity, and contextual conditions as interconnected barriers to technology integration in rural schools. Norman (2023) similarly finds that successful educational technology interventions in developing countries are more likely to involve ongoing teacher development, context-specific resources, community engagement, and integration with broader pedagogy.

The East Sumba case consequently suggests that national digital education policy should operate through differentiated implementation standards. Rather than requiring identical technological practices everywhere, the state should establish common educational objectives while allowing different technological pathways to achieve them. For example, a learning objective requiring students to access instructional content could be achieved through streaming in high-connectivity areas, downloadable resources in moderate-connectivity areas, and offline digital packages or school-based local servers in low-connectivity communities. The objective remains nationally consistent, but the technological means are adapted to local conditions.

Offline and Low-Bandwidth Education as Digital Justice

One of the most important implications of this analysis is that digital justice does not necessarily mean maximizing online connectivity. In some circumstances, insisting on continuous connectivity may actually deepen inequality. A more just policy may combine online and offline technologies according to local conditions.

This principle is consistent with the East Sumba experience of semi-online learning. Nahumury and Antony (2022) found that semi-online models were used to maintain educational activity where internet limitations made fully online instruction difficult. Such models can include downloadable materials, local servers, USB-based content distribution, school Wi-Fi without internet, printed materials linked to digital resources, educational radio, and asynchronous messaging. UNESCO's analysis also emphasizes that technology should be selected according to context and learning objectives rather than treated as an end in itself. The 2023 GEM Report notes that technology's educational effects vary substantially across contexts and that the most disadvantaged groups may be excluded from its benefits.

An offline-first approach is particularly relevant to East Sumba because it recognizes connectivity as a variable rather than a constant. Teachers could prepare learning resources that remain functional when the internet is unavailable. Students could download materials during periods of connectivity and continue learning offline. Assessment could be synchronized periodically rather than requiring continuous online access. Such an approach would also improve resilience. A digitally just education system should be capable of continuing during network outages, electricity interruptions, extreme weather, or other infrastructure disruptions. Digital resilience is therefore part of educational justice because students in remote communities should not lose educational continuity simply because their infrastructure is less reliable.

Community-Based Digital Support

Digital transformation also requires institutions between the school and the household. Teachers cannot solve every connectivity problem, particularly when students face difficulties outside school. Community-based digital support can therefore provide an important intermediary structure.

Community centers, village offices, libraries, youth organizations, churches, and other local institutions can potentially serve as shared access points for educational technology. Such arrangements can reduce the need for every household to possess the same technological resources.

The principle is consistent with the broader literature on digital inclusion, which emphasizes the importance of social and institutional support in converting technological access into meaningful participation (Warschauer 2004; Lwoga and Sangeda 2019). (onlinelibrary.wiley.com) In remote areas, community institutions

may also possess greater knowledge of local conditions than centralized administrative agencies.

The Indonesian experience during the pandemic demonstrated the importance of local adaptation. Teachers frequently relied on familiar communication platforms, informal networks, and locally negotiated arrangements rather than implementing centrally designed online systems exactly as intended. This indicates that policy implementation is not simply a top-down process. Local actors actively reinterpret policy according to available resources. Community-based support should therefore not be understood as a substitute for state responsibility. The state remains responsible for ensuring adequate infrastructure and educational quality. Community involvement should instead complement public provision by providing local knowledge, shared resources, and social support.

Toward a Digital Justice Framework for East Sumba

The preceding analysis suggests that digital education policy in East Sumba should be reorganized around five principles. First, infrastructure equity requires targeted investment in electricity and connectivity in communities with the greatest deficits. Resource allocation should not simply follow population size because the cost of reaching remote communities can be considerably higher. Schools and villages with the greatest infrastructural barriers should receive stronger affirmative support. Second, meaningful connectivity should replace simple connection targets. Evaluation should include reliability, affordability, bandwidth, device availability, and the frequency with which students can actually use digital resources for learning. A school should not be classified as digitally ready merely because a network signal technically reaches its premises.

Third, teacher digital capability should be treated as core education infrastructure. Professional development should be continuous and locally contextualized, combining technical training with pedagogy and classroom application. Remote teachers should have access to mentoring, peer networks, and technical support rather than being expected to develop digital competence independently. Fourth, modal flexibility should be institutionalized. National policy should permit online, hybrid, semi-online, offline-first, radio-supported, and other approaches depending on local infrastructure. The objective should be common learning standards rather than identical technological procedures. Fifth, community participation and local monitoring should be incorporated into digital education governance. Local communities can identify connectivity gaps, device-sharing problems, and barriers that may not be visible in centralized administrative datasets. This would make digital policy more responsive to actual educational conditions.

These principles can be summarized as a shift from digital equality to digital equity. Digital equality asks whether everyone receives the same technological input. Digital equity asks whether everyone receives the support necessary to use

technology for comparable educational purposes. The latter is more demanding but also more compatible with the principles of educational justice.

Conclusion

Digital transformation has considerable potential to improve educational access, particularly in geographically isolated regions such as East Sumba. However, technology cannot be assumed to be inherently equalizing. Digital education operates through an infrastructure and capability system in which electricity, connectivity, devices, household resources, teacher competence, educational content, and institutional support are mutually dependent. Where these resources are unequally distributed, the same digital policy can produce substantially different educational experiences. The East Sumba case demonstrates why digital justice should be understood as substantive rather than merely formal equality. Providing a platform, device, or internet connection does not guarantee meaningful participation. Students require reliable connectivity, appropriate devices, affordable access, digital skills, supportive teachers, and learning environments that allow technology to function educationally. The persistence of infrastructural differences in East Nusa Tenggara, together with evidence from rural Indonesian schools, indicates that national digitalization policies must take territorial inequality seriously. The appropriate response is not to abandon educational technology but to implement it differently. East Sumba requires a differentiated digital education strategy that combines infrastructure investment with teacher development, offline and low-bandwidth alternatives, community-based support, and locally responsive implementation. Digital justice ultimately requires judging technological policy not by how much technology is distributed, but by whether technology expands students' real capabilities to learn. In this sense, learning without a signal should not be interpreted simply as a technological failure. It represents a policy challenge: when connectivity is unavailable, the education system must provide another pathway to learning. A just digital education policy is therefore one that refuses to allow the absence of a signal to become an absence of educational opportunity.

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Education is never neutral. It is always linked to questions of power, social justice, and the struggle for a meaningful democracy.

Henry Giroux
Critical Pedagogy Theorist

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