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From Digitalization to Inequality: Implementing Education Technology Policy in Disadvantaged Schools in East Nusa Tenggara

Lukas Ndjurumana*
Institut Agama Kristen Negeri Kupang, Kupang, Indonesia
lukas_ndjurumana@gmail.com

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*Corresponding Author

Abstract

National digitalization policies often assume that schools possess sufficient infrastructure to adopt technology-enhanced learning. This assumption becomes problematic in disadvantaged regions where schools continue to experience shortages in electricity, internet connectivity, equipment, and technical support. This study examines the implementation gap between national education technology policy and school-level realities in disadvantaged areas of East Nusa Tenggara (NTT). The research focuses on how schools interpret, adapt, and negotiate technology-oriented policy requirements under conditions of infrastructural scarcity. A qualitative multiple-case study design is proposed, involving selected primary and secondary schools with different levels of technological readiness. Data are analyzed through an implementation justice framework emphasizing unequal institutional capacity, resource distribution, and policy responsiveness. The study argues that identical policy requirements can generate unequal burdens when schools operate under fundamentally different material conditions. Rather than interpreting limited technology adoption as institutional failure, the research conceptualizes it as a structural policy problem. The study further examines whether current revitalization and infrastructure interventions sufficiently address the broader ecosystem required for meaningful digital learning. It recommends integrating digital policy with infrastructure development, teacher training, maintenance systems, and context-sensitive implementation targets. The research contributes to international scholarship by demonstrating how territorial inequalities mediate the implementation of national digital education reforms.

[*National digitalization policies often assume that schools possess sufficient infrastructure to adopt technology-enhanced learning. This assumption becomes problematic in disadvantaged regions where schools continue to experience shortages in electricity, internet connectivity, equipment, and technical support. This study examines the implementation gap between national education technology policy and school-level realities in* *disadvantaged areas of East Nusa Tenggara (NTT). The research focuses on how schools interpret, adapt, and negotiate technology-oriented policy requirements under conditions of infrastructural scarcity. A qualitative multiple-case study design is proposed, involving selected primary and secondary schools with different levels of technological readiness. Data are analyzed through an implementation justice framework emphasizing unequal institutional capacity, resource distribution, and policy responsiveness. The study argues that identical policy requirements can generate unequal burdens when schools operate under fundamentally different material conditions. Rather than interpreting limited technology adoption as institutional failure, the research conceptualizes it as a structural policy problem. The study further examines whether current revitalization and infrastructure interventions sufficiently address the broader ecosystem required for meaningful digital learning. It recommends integrating digital policy with infrastructure development, teacher training, maintenance systems, and context-sensitive implementation targets. The research contributes to international scholarship by demonstrating how territorial inequalities mediate the implementation of national digital education reforms.*]

Keywords: education technology, policy implementation, digital inequality, 3T regions, East Nusa Tenggara

Introduction

Digitalization has become one of the most prominent directions in contemporary education reform. Governments increasingly regard digital platforms, learning management systems, electronic resources, connected devices, online assessment, and digital administrative systems as essential components of modern schooling. The policy rationale is compelling: digital technology can potentially broaden access to educational resources, facilitate communication, support personalized learning, strengthen teacher professional development, and reduce some of the geographical constraints associated with conventional education. However, the expansion of digital technology does not take place in an educational landscape characterized by equal resources. UNESCO's *Global Education Monitoring Report 2023* explicitly cautions that technology can either support or undermine educational equity depending on the conditions under which it is introduced, emphasizing that access, governance, teacher capacity, appropriateness, and sustainability must be considered alongside technological provision (UNESCO 2023). Thus, digitalization should not be treated as a neutral technological process but as a policy intervention whose consequences depend on the social and institutional environments in which it is implemented.

The problem becomes particularly significant in disadvantaged, remote, and geographically fragmented regions. In such contexts, schools may operate with limited electricity, unstable internet connectivity, inadequate digital equipment, weak technical support, and fewer opportunities for teachers to develop technological competencies. These constraints are not distributed evenly even within the same province. The *Education Statistics of Nusa Tenggara Timur Province 2024*, published by Statistics Indonesia, explicitly includes indicators concerning student ICT use and allows comparison of educational participation and technology use across the province. The publication is based primarily on the March 2024 National Socio-Economic Survey and provides an important empirical basis for examining educational and digital disparities in NTT (BPS-Statistics Indonesia, NTT Province 2025).

The central problem, therefore, is not simply that disadvantaged schools have "less technology." Rather, they frequently confront a different implementation environment. A policy requiring schools to use a digital learning platform may appear formally equal because every school is subject to the same requirement. Yet the costs of compliance can vary dramatically. A school in Kupang with stable electricity, broadband access, trained teachers, and students possessing personal devices faces a fundamentally different implementation task from a school in a remote district where teachers and students must share devices, rely on intermittent mobile connectivity, or travel to locations with stronger signals. Formal policy equality consequently does not necessarily produce equal policy capacity.

This distinction is increasingly important because digital inequality has moved beyond the conventional question of whether people are connected to the internet. van Deursen and van Dijk (2014) demonstrate that the digital divide increasingly concerns differences in the ways people use digital technologies rather than merely whether they have access to them. Warschauer (2004) similarly argues that meaningful technological inclusion depends upon physical resources, skills, social support, and institutional conditions. A school may therefore possess computers without possessing the institutional capacity to convert those computers into meaningful educational opportunities. Likewise, students may technically have access to the internet while lacking the bandwidth, device quality, affordability, or digital skills necessary to participate effectively in technology-mediated learning.

This issue is particularly salient in Indonesia, where national education technology initiatives have expanded considerably. The COVID-19 pandemic accelerated the adoption of digital learning and demonstrated both the potential and limitations of educational technology. The World Bank observed that Indonesia's education system was not equally prepared for rapid online learning, with rural students and lower-income households facing particular constraints in connectivity and device ownership (World Bank 2020). The pandemic thus revealed that digital learning capacity was closely associated with pre-existing socioeconomic and territorial inequalities rather than being uniformly available across the education system.

East Nusa Tenggara represents a particularly important setting for investigating this issue. The province contains numerous rural and geographically dispersed communities in which the provision of public services can be more difficult and costly than in densely populated urban areas. The provincial education statistics show that disparities in ICT use persist between urban and rural students. The 2024 publication, for example, reports substantial differences in students' use of mobile phones, computers, and internet services according to urban-rural residence (BPS-Statistics Indonesia, NTT Province 2025). Such differences are not merely indicators of household technology consumption. In a digitalizing education system, they increasingly influence students' ability to access instructional materials, communicate with teachers, complete assignments, and participate in digitally mediated learning.

The problem also extends to schools' organizational capacity. Technology integration requires more than the delivery of hardware. It requires electricity, connectivity, maintenance, teacher competence, pedagogical adaptation, technical assistance, and appropriate content. Mustafa, Nguyen, and Gao's (2024) systematic review of technology integration in rural schools identified twenty-nine challenges across macro, meso, and micro levels. Their findings demonstrate that rural technology integration is shaped by interconnected infrastructural, institutional, teacher, and student factors rather than by a single technology-access variable. This is especially relevant for NTT because a school that receives devices without corresponding improvements in connectivity, technical support, or teacher capacity may experience little substantive change in classroom practice.

The concept of implementation justice provides a useful framework for interpreting these conditions. Conventional policy implementation research frequently asks whether policy objectives are translated successfully into organizational practice (Pressman and Wildavsky 1984; Matland 1995). An implementation-justice perspective adds another question: Are implementation requirements distributed fairly across institutions with unequal capacities? This shifts the analytical focus from whether schools comply with policy to whether policy itself recognizes the unequal conditions under which compliance is expected.

The article consequently argues that technology adoption in disadvantaged schools should not be evaluated solely through indicators such as the number of devices distributed, schools connected to the internet, teachers trained, or platforms activated. Such indicators are useful but insufficient. The more important question is whether technological interventions increase students' actual capacity to learn. This requires examining the relationship between infrastructure, institutional capacity, teacher competence, household resources, and the design of policy implementation. The study asks three related questions: First, how do territorial and institutional inequalities shape the implementation of education technology policy in disadvantaged schools in NTT? Second, why can identical technology requirements generate unequal implementation burdens? Third, what policy arrangements are necessary to transform digitalization into substantive rather than merely formal educational inclusion? The article contributes to the literature by connecting digital inequality with policy implementation and distributive justice, arguing that technological underuse in disadvantaged schools should often be interpreted as a structural implementation problem rather than simply an institutional deficiency.

The first body of literature conceptualizes digital inequality as a multidimensional phenomenon. Early research frequently measured the digital divide through access to computers and the internet. Subsequent scholarship demonstrated, however, that access is only the first stage of technological inclusion. van Dijk (2005) conceptualizes digital inequality through motivational, material, skills, and usage dimensions, while Warschauer (2004) emphasizes the importance of social resources and institutional support in converting technology into meaningful participation. Hargittai (2002) similarly demonstrates that individuals with nominally similar internet access can possess very different levels of online skills. These studies provide an important conceptual foundation for understanding schools because technological availability does not automatically translate into technological capability.

The literature subsequently shifted toward the relationship between digital inequality and socioeconomic inequality. Robinson et al. (2015) argue that digital inequalities are embedded within broader structures of social inequality. Helsper (2012) similarly conceptualizes digital exclusion as interconnected with social exclusion, suggesting that disadvantages in one domain can reinforce disadvantages in another. This perspective is particularly relevant to education because students' technological opportunities are shaped by family income, parental education, household infrastructure, social networks, and school resources. Technology may therefore function as both a potential equalizer and a mechanism through which existing inequalities are reproduced.

Recent scholarship has extended this argument to education specifically. Martin, Ceviker, and Gezerc (2024), through a systematic review of two decades of research, demonstrate that educational digital inequality encompasses differences in socioeconomic status, geography, school characteristics, parental education, digital skills, and access to technological resources. Their work reinforces the argument that the digital divide cannot be reduced to the question of whether students have internet access. It is also a question of whether they possess the capabilities and institutional conditions necessary to benefit educationally from digital technologies.

A second strand of research focuses on technology integration in rural and under-resourced schools. Rural schools often confront multiple and overlapping constraints, including weak connectivity, limited technical support, teacher shortages, smaller student populations, geographic isolation, and restricted professional development opportunities. Mustafa, Nguyen, and Gao (2024) provide particularly strong evidence through a systematic review of 36 studies, identifying

29 challenges associated with technology integration in rural schools. Their ecological analysis demonstrates that these challenges occur simultaneously at macro, meso, and micro levels. This finding challenges approaches that locate the problem solely within teachers' technological competence or schools' willingness to adopt technology.

Earlier research similarly demonstrates that technology integration depends heavily on teacher beliefs, confidence, pedagogical knowledge, and organizational support. Ertmer and Ottenbreit-Leftwich (2010) argue that effective technology integration involves the interaction of knowledge, confidence, beliefs, and school culture. Buabeng-Andoh (2012) identifies teacher and institutional factors as significant determinants of ICT adoption. These findings suggest that providing equipment without developing human and organizational capacity is unlikely to produce sustainable technological change. Research from lower-resource settings reinforces the same conclusion. Drossel, Eickelmann, and Bos (2022) show that technology-mediated professional development can expand teachers' learning opportunities in low- and middle-income countries but that successful professional development requires sustained support and contextual adaptation. Similarly, Norman (2023) demonstrates that educational technology interventions in developing-country contexts are more likely to be effective when technology is combined with teacher support, appropriate pedagogy, and local contextualization. Technology integration is consequently better understood as an institutional change process than as a procurement exercise.

A third body of literature concerns digital education in Indonesia. The country's experience during the COVID-19 pandemic exposed substantial inequalities in digital learning capacity. Kusuma (2020), examining English language teaching in rural Indonesian schools, found that teachers faced significant difficulties associated with internet access, devices, student participation, and the sudden transition to online teaching. Setiawan and Iasha (2020) similarly documented the challenges of fully online learning in rural elementary schools, demonstrating that technological limitations shaped both the feasibility and quality of remote instruction. These studies are complemented by evidence from Indonesian policy and development reports. The World Bank (2020) observed that many rural Indonesian students lacked the connectivity and devices necessary for online learning and noted that lower-tech alternatives such as television could provide wider reach than internet-dependent systems. The lesson is important: technological sophistication does not necessarily correspond to educational inclusiveness. A technology that is highly effective for connected students can be less equitable than a simpler technology if the latter reaches a larger proportion of disadvantaged learners.

The NTT context adds another layer to this literature. Provincial statistical data show that ICT use among students varies substantially by geographical location. The 2024 education statistics report that urban-rural disparities remain evident in mobile-phone, computer, and internet use, with computer use particularly differentiated between urban and rural students (BPS-Statistics Indonesia, NTT Province 2025). This suggests that the implementation environment for technology-based education is structurally differentiated across the province.

There is also evidence that technological provision alone does not guarantee effective utilization. SEAMEO SEAMOLEC reported that schools in Ende District received Chromebook devices, but their utilization remained limited, prompting collaboration among the district government, education authorities, quality assurance institutions, SEAMOLEC, and local educational organizations to strengthen teacher capacity and maximize the use of the equipment (SEAMEO SEAMOLEC 2024). This case is highly relevant to the present argument because it demonstrates how the implementation problem extends beyond the distribution of hardware. Taken together, the previous studies establish three important propositions. First, digital inequality is multidimensional. Second, technology integration in rural schools is an organizational and infrastructural process rather than a simple question of equipment. Third, Indonesian digital education policy encounters substantial territorial variation. However, a gap remains in connecting these strands to policy implementation justice. Much of the literature asks why schools fail to adopt technology or what barriers prevent technology integration. This article instead asks whether the policy conditions themselves are equitable when imposed upon institutions with radically different capacities.

This study employs a qualitative multiple-case policy-analysis design. The geographical focus is East Nusa Tenggara, with particular attention to disadvantaged and geographically remote schools. Because the article is designed as a policy case study rather than a statistical evaluation of individual schools, the evidence base consists primarily of documentary materials: official provincial statistics, national policy documents, education reports, international development reports, and peer-reviewed scholarship on digital inequality and rural education. The *Education Statistics of Nusa Tenggara Timur Province 2024* is used as a principal empirical reference because it incorporates data from the March 2024 Susenas and reports indicators concerning student ICT use, educational participation, and educational progression. The analysis proceeds through thematic interpretation. Documents were examined according to four analytical categories: resource distribution, institutional capacity, contextual responsiveness, and substantive educational access. These categories were then connected to implementation theory and digital-divide scholarship. The analysis does not treat technology adoption rates as direct evidence of institutional effectiveness. Instead, differences in adoption are interpreted in relation to the resources and constraints available to schools. This approach is intended to avoid attributing structural policy problems to individual teachers or school leaders.

The Implementation Gap: When National Standards Meet Unequal Local Capacity

The central implementation problem in digital education policy emerges from the assumption that schools are sufficiently similar to respond to common policy requirements. National policies typically establish common objectives, standards, platforms, or technological expectations. Such uniformity is administratively understandable because national systems require common benchmarks and mechanisms for accountability. However, the implementation of a common standard becomes problematic when the institutions responsible for implementing it possess substantially different resources.

> The situation can be conceptualized through the relationship:
> Common policy requirement + unequal institutional capacity = unequal implementation burden.

A connected urban school may fulfill a digital assignment through existing broadband, computers, electricity, and teacher expertise. A remote school may need to overcome several additional barriers before reaching the same point. Teachers may have to travel to obtain connectivity, students may share devices, and school administrators may have to spend scarce institutional resources maintaining equipment. Consequently, the policy may impose a much higher opportunity cost on disadvantaged schools.

This distinction is central to implementation theory. Pressman and Wildavsky (1984) demonstrated that implementation is not a mechanical process in which policy decisions automatically translate into outcomes. Multiple actors, resources, and institutional relationships intervene between policy formulation and implementation. Matland (1995) further shows that ambiguity and conflict can shape how policies are interpreted at the local level. Digital education policies are particularly susceptible to this problem because technology-related requirements often leave considerable room for local adaptation.

The implication is that a school with low levels of technology adoption should not immediately be categorized as resistant or ineffective. Its behavior may represent a rational adaptation to infrastructural scarcity. If internet access is unreliable, teachers may prefer printed materials or asynchronous communication. If devices are insufficient, schools may organize group use. If online platforms consume too much data, teachers may use simpler messaging applications. Such practices can appear as "non-compliance" when evaluated against a technologically standardized policy, but they may actually represent locally rational implementation. The implementation gap is therefore partly produced by the policy itself. When national policymakers assume that technological readiness is evenly distributed, they risk converting territorial inequality into institutional inequality. Schools in disadvantaged areas are effectively judged against standards developed under conditions they do not share.

Infrastructure as a Condition of Policy Implementation

Technology-based education cannot function independently of physical infrastructure. Electricity, connectivity, devices, and maintenance constitute the material foundation upon which digital policy depends. Without these elements, pedagogical innovation becomes difficult regardless of teachers' willingness or competence. Evidence from NTT illustrates the importance of this infrastructure chain. The provincial education statistics include indicators of student ICT use and demonstrate substantial differences between urban and rural students. In the 2024 dataset, approximately 84 out of 100 urban students used mobile phones during the relevant period compared with approximately 71 out of 100 rural students; the urban-rural gap was considerably larger for computer use. These figures demonstrate that students do not enter digital education from equivalent technological positions.

The implications for schools are substantial. If students have unequal access to devices at home, a school cannot assume that digital homework will impose equal burdens. If computer access is concentrated among urban students, online assignments requiring document creation or specialized software will disproportionately disadvantage rural learners. Similarly, if connectivity is unreliable, synchronous learning may be unrealistic even when a school technically has internet access.

The problem is reinforced when policy monitoring focuses on the existence of infrastructure rather than its quality. A school may be categorized as "connected" while experiencing slow speeds, frequent outages, expensive data costs, or insufficient bandwidth for simultaneous use. This produces a misleading implementation indicator. What matters educationally is not nominal connection but functional connectivity.

Mustafa, Nguyen, and Gao (2024) emphasize that rural technology integration is constrained by multiple interacting factors at macro, meso, and micro levels. This suggests that infrastructure interventions should be coordinated rather than fragmented. Providing devices without electricity or internet access creates limited value; providing internet without teacher support similarly limits pedagogical impact. Infrastructure should consequently be understood as a policy ecosystem. Digital education investment should include connectivity, electricity, devices, maintenance, technical support, and replacement mechanisms. Otherwise, initial investment may create temporary technological visibility without long-term institutional capability.

From Device Distribution to the Problem of Technological Capacity

The distribution of devices is one of the most visible forms of education technology intervention. Devices are tangible, countable, and politically communicable. Governments can report how many laptops or tablets have been distributed and how many schools have received them. Yet the number of devices distributed says relatively little about whether educational transformation has occurred.

The Ende District experience illustrates this problem. SEAMOLEC reported that thousands of Chromebook devices had been provided to schools in Ende, but their utilization remained limited. The subsequent intervention involved cooperation among district authorities, education offices, the provincial quality assurance institution, SEAMOLEC, and educational organizations to strengthen teachers' capacity and maximize the use of the equipment (SEAMEO SEAMOLEC 2024).

This case illustrates a broader principle: technology is an enabling resource, not an educational outcome. A device becomes educationally valuable only when it is embedded in a functioning system of curriculum, pedagogy, teacher competence, content, infrastructure, and technical support. Ertmer and Ottenbreit-Leftwich (2010) emphasize that effective technology integration depends on teachers' knowledge, confidence, beliefs, and school culture. Buabeng-Andoh (2012) similarly identifies organizational and teacher-level factors as important determinants of ICT adoption. These findings suggest that technological procurement and professional development should be planned as a single intervention rather than as separate programs.

This also raises the issue of maintenance. Technology programs often receive substantial attention during the procurement and distribution stages but less attention during the post-distribution period. Devices require repair, software updates, replacement components, charging infrastructure, cybersecurity protection, and technical assistance. In remote schools, maintenance costs can be particularly high because technicians may be geographically distant. Consequently, digital education policy should adopt a total cost of educational technology ownership perspective. The relevant policy question is not "How many devices can be distributed?" but "What resources are required to keep these devices educationally functional for five or ten years?" This shift would produce more realistic and equitable investment decisions.

Teachers as Policy Implementers Rather Than Technology Recipients

Teachers occupy a central position in the implementation process. They translate policy language into classroom practices and determine whether digital tools are integrated meaningfully into learning. However, policy often treats teachers primarily as recipients of technology rather than as policy actors. This distinction matters because teachers interpret policy according to their local circumstances. A teacher who lacks reliable internet may redesign a digital lesson as an asynchronous activity. Another may download materials when connectivity is available and distribute them offline. A third may use WhatsApp because students are already familiar with it. These practices represent forms of policy adaptation.

Technology adoption research consistently emphasizes the importance of teacher capacity. Buabeng-Andoh (2012) identifies teacher attitudes, competence, and institutional factors as determinants of ICT integration. Ertmer and Ottenbreit-Leftwich (2010) argue that teachers require more than technical skills; they also need pedagogical knowledge and confidence in using technology. Professional development is therefore a critical component of implementation justice. Drossel, Eickelmann, and Bos (2022) demonstrate that technology-mediated professional development can expand opportunities for teachers in low- and middle-income countries but also show the importance of sustained support. Training should not consist of isolated workshops that introduce teachers to a platform and then assume autonomous implementation.

In NTT, teacher development should be particularly sensitive to local infrastructure. Teachers should be trained not only in high-bandwidth digital pedagogy but also in low-bandwidth and offline instructional strategies. They should be able to design materials that can be downloaded once and reused offline, compress educational resources, use asynchronous communication, and combine digital and non-digital materials. Such training would redefine technological competence as contextual pedagogical competence. The goal is not to make every teacher use the most sophisticated technology available. The goal is to enable teachers to select and use the most appropriate technology given the educational objective and local constraints.

Territorial Inequality and the Unequal Cost of Compliance

A particularly important consequence of uniform digital policy is the unequal distribution of compliance costs. A national requirement can impose different financial, temporal, and organizational burdens depending on geographical conditions. For a well-connected school, uploading materials to a digital platform may take minutes. For a remote school, the same activity may require teachers to travel, purchase additional data, wait for network availability, or use personal devices. The formal requirement is identical, but the implementation cost is not.

This can be understood through the principle of horizontal versus vertical equity. Horizontal equity treats similarly situated institutions similarly. Vertical equity recognizes that institutions with substantially different circumstances may require different levels or forms of support. Digital education policy in NTT requires the latter. The argument is supported by the province's ICT-use statistics. Urban-rural disparities demonstrate that students and households do not have equal technological resources. If student conditions differ, schools cannot reasonably be expected to implement digital learning using identical assumptions about students' technological capacity.

The same logic applies to school-level accountability. If schools are evaluated according to technology-use indicators without accounting for infrastructure and socioeconomic context, disadvantaged schools may be systematically penalized. A school may appear to have low digital adoption because it lacks capacity rather than motivation. Implementation justice therefore requires context-adjusted accountability. Schools should be evaluated according to common educational goals while being provided differentiated pathways and resources to reach those goals.

The Role of Low-Tech and Offline Alternatives

The pursuit of digital transformation can paradoxically become less equitable when policy assumes that the internet is universally available. A more sophisticated approach is to recognize a spectrum of technological modalities.

The World Bank's analysis of Indonesian education technology during the COVID-19 pandemic provides an important example. It noted that rural students and lower-income households faced substantial constraints in accessing online education and highlighted television as an example of a lower-tech medium capable of reaching a broader share of students (World Bank 2020). The lesson is not that television should replace digital platforms, but that technology should be evaluated according to reach and educational function rather than technological sophistication alone.

In NTT, offline and low-bandwidth options can include downloadable learning materials, local school servers, USB-based content distribution, printed materials combined with digital resources, asynchronous messaging, radio, educational television, and periodic synchronization of student data. These approaches can preserve elements of digital learning while reducing dependence on continuous internet access.

Such flexibility is consistent with the evidence from rural technology research. Mustafa, Nguyen, and Gao (2024) conclude that effective technology integration requires attention to contextual conditions and multiple levels of intervention. Similarly, the broader literature on digital inequality emphasizes that meaningful inclusion requires adaptation to users' actual technological capabilities rather than simply imposing universal technological requirements. An offline-first approach also improves resilience. Rural schools may experience network disruptions, electricity failures, extreme weather, or equipment breakdowns. A learning system dependent entirely on continuous connectivity is vulnerable to such interruptions. A hybrid system, by contrast, can maintain educational continuity even when online access temporarily fails.

Rethinking Policy Evaluation: From Adoption to Educational Capability

The ultimate purpose of education technology policy is not digitalization itself but educational improvement. Policy evaluation should therefore move beyond input and activity indicators toward measures of educational capability. A school with 100 computers may still provide poor digital learning if teachers lack pedagogical support, devices are broken, connectivity is unstable, or students cannot access the required resources at home. Conversely, a school with relatively modest technological resources may provide meaningful digital learning if teachers use those resources effectively and adapt them to local conditions.

This suggests a four-level evaluation framework. The first level is availability: Are infrastructure and devices present? The second is functionality: Can the resources operate reliably and affordably? The third is pedagogical integration: Are teachers able to use technology in ways that support learning objectives? The fourth is educational capability: Do students actually gain greater opportunities to learn because of the technology? The distinction is critical because policy success can occur at one level and fail at another. A government may achieve high device-distribution targets while producing limited pedagogical change. Conversely, a school may have modest technological resources but demonstrate strong educational use. UNESCO's 2023 GEM Report emphasizes precisely this concern: technology should be evaluated according to whether it is appropriate, equitable, evidence-based, and sustainable rather than merely whether it has been introduced (UNESCO 2023). The same principle should guide evaluation in NTT.

Toward an Implementation-Justice Model for Disadvantaged Schools

The analysis suggests that digital education policy in NTT should be organized around a differentiated implementation model. First, universal educational objectives should be retained. Students across Indonesia should have access to comparable learning opportunities and educational standards. Territorial adaptation should not become an excuse for lower expectations. Second, implementation pathways should be differentiated. Schools should be permitted to select online, blended, semi-online, or offline-first models according to their technological conditions. The national system should establish learning outcomes rather than requiring identical technological processes. Third, affirmative infrastructure investment should be geographically targeted. Schools experiencing the greatest infrastructure deficits should receive additional support rather than simply receiving the same package as better-resourced schools. This is a principle of vertical equity.

Fourth, teacher development should be continuous and contextualized. Teachers need technical training, pedagogical training, mentoring, peer networks, and local technical support. Training should include low-bandwidth teaching strategies. Fifth, maintenance must be institutionalized. Technology budgets should include repair, replacement, technical assistance, connectivity costs, electricity, software, and cybersecurity. Without these components, initial investments may deteriorate rapidly. Sixth, monitoring should measure meaningful educational use rather than merely technology adoption. Indicators should include student participation, continuity of learning, teacher use, reliability, and learning outcomes, while also accounting for territorial context.

Finally, policy evaluation should distinguish institutional failure from structural constraint. A school that cannot implement an online platform because its connectivity is inadequate should not be judged in the same manner as a well-connected school that simply refuses to use available resources. Accountability must remain strong, but it must also be fair.

Conclusion

The implementation of education technology policy in East Nusa Tenggara demonstrates that digitalization is not inherently synonymous with educational equality. National policies may establish common technological objectives, but schools encounter these objectives from profoundly different starting positions. Differences in electricity, connectivity, devices, teacher competence, maintenance, technical support, and household resources mean that identical requirements can generate substantially different implementation burdens. The resulting inequalities should not automatically be interpreted as evidence of institutional failure. In many cases, they reflect a structural mismatch between national policy assumptions and local implementation capacity. The evidence further suggests that technology distribution alone is insufficient to produce meaningful digital transformation. The experience of schools in NTT, including the limited initial utilization of Chromebook devices in Ende, demonstrates the importance of teacher capacity, institutional coordination, technical assistance, and contextual adaptation. Likewise, provincial data demonstrate persistent urban-rural differences in student ICT use, indicating that digital education policies operate within a broader landscape of socioeconomic and territorial inequality.

A more just approach therefore requires a transition from uniform digitalization to differentiated digital inclusion. National governments should maintain common educational objectives while allowing schools to employ different technological pathways according to local conditions. Infrastructure investment should be affirmative, teacher development continuous, maintenance adequately funded, and offline or low-bandwidth alternatives formally recognized. Most importantly, policy evaluation should move from measuring how much technology is distributed toward assessing whether students actually gain meaningful educational capabilities. The central policy lesson is consequently straightforward: digital equality cannot be achieved by giving unequal schools the same technological requirements. If digitalization is to reduce rather than reproduce educational inequality, implementation must recognize territorial difference as a legitimate basis for differentiated support. In disadvantaged regions such as East Nusa Tenggara, justice in digital education is therefore not a matter of providing less technology or more technology, but of providing the right combination of technology, infrastructure, human capacity, and institutional support required to make learning possible.

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