Digital and Physical Gaps in Access to Education: A Comparative Study of Urban–Rural Educational Infrastructure in Indonesia

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Abstract: *Equitable access to education is a fundamental prerequisite for national progress, yet the infrastructure gap between urban and rural areas in Indonesia remains a crucial issue. This gap manifests in two main dimensions: physical and digital, both significantly impacting the quality of learning. This research aims to map and synthesize findings from various literature concerning the comparison of physical and digital education infrastructure between schools in urban and rural Indonesia. The research method used is a systematic literature review, examining relevant journal articles, government reports, and scientific publications from the last ten years. The synthesis results show a consensus in the literature that a sharp disparity exists. The literature consistently reports the superiority of urban schools in terms of building quality, laboratory completeness, and library facilities. On the other hand, the digital gap is also highly significant, with internet penetration and speed in rural schools lagging far behind. This study concludes that this dual gap creates systemic barriers for rural students and recommends the need for integrated intervention policies to address both dimensions of the gap simultaneously.*

Keywords : *education gap, physical infrastructure, digital infrastructure, urban-rural, literature study*

Abstrak: Akses pendidikan yang merata merupakan prasyarat fundamental bagi kemajuan bangsa, namun kesenjangan infrastruktur antara wilayah urban dan rural di Indonesia masih menjadi isu krusial. Kesenjangan ini termanifestasi dalam dua dimensi utama: fisik dan digital, yang keduanya berdampak signifikan terhadap kualitas pembelajaran. Penelitian ini bertujuan untuk memetakan dan mensintesis temuan-temuan dari berbagai literatur mengenai perbandingan infrastruktur pendidikan fisik dan digital antara sekolah di wilayah urban dan rural di Indonesia. Metode penelitian yang digunakan adalah studi literatur sistematis, dengan menelaah artikel jurnal dan publikasi ilmiah relevan dalam sepuluh tahun terakhir. Hasil sintesis menunjukkan konsensus dalam literatur bahwa terdapat disparitas yang tajam. Literatur secara konsisten melaporkan keunggulan sekolah urban dalam hal kualitas bangunan, kelengkapan laboratorium, dan perpustakaan. Di sisi lain, kesenjangan digital juga sangat signifikan, di mana penetrasi dan kecepatan internet di

sekolah rural jauh tertinggal. Studi ini menyimpulkan bahwa kesenjangan ganda ini menciptakan hambatan sistemik bagi siswa di perdesaan dan merekomendasikan perlunya kebijakan intervensi yang terintegrasi untuk mengatasi kedua dimensi kesenjangan tersebut secara simultan.

Kata kunci: kesenjangan pendidikan, infrastruktur fisik, infrastruktur digital, urban-rural, studi literatur

Introduction

Education holds an indisputable role as the primary foundation for the development of civilization and the advancement of a nation, where the quality of superior human resources is a direct outcome of an effective and equitable education system. In Indonesia, efforts to realize access to quality education for all citizens have long been a priority agenda in every long-term development plan. However, conditions in the field still reveal significant challenges rooted in sharp disparities between urban and rural areas (Ayuningtyas, 2021; Berliana et al., 2024; Vito et al., 2016).

This gap is no longer limited to classical issues such as teacher availability but has evolved into a multidimensional problem encompassing two interrelated and crucial aspects: physical infrastructure and digital infrastructure (Vito et al., 2016). The urgency of this study is grounded in the premise that unequal access to adequate educational facilities—both physical and digital—fundamentally perpetuates cycles of social and economic inequality, thereby potentially hindering the realization of inclusive and sustainable national development. Numerous relevant studies show that the quality of school infrastructure is strongly correlated with student learning outcomes, where students in urban areas statistically demonstrate higher academic achievement, largely due to the superior facilities available to them (Pratama, 2022).

The fundamental issue highlighted in this study is the dual gap simultaneously experienced by students in rural areas. On one hand, they face limitations in physical infrastructure, such as inadequate school buildings, limited availability of libraries with relevant collections, and the absence of functional science laboratories to support practical learning (Purwanti, 2022). On the other hand, along with the accelerating digital transformation in the education sector, a new and equally complex divide has emerged—namely, the digital gap. This phenomenon is manifested in limited access to stable and affordable internet connections, low levels of technological device ownership, and minimal digital literacy among both students and teachers. This is confirmed by findings indicating that more than 60% of schools in underdeveloped regions remain without adequate internet connectivity (Ministry of Communication and Informatics, 2023, pp. 22–25).

Therefore, this study is designed with the primary objective of conducting a comprehensive comparative analysis to map, analyze, and interpret in depth the

dimensions of physical and digital infrastructure disparities in educational access between urban and rural areas in Indonesia. The usefulness of this research lies in providing an evidence-based analysis that can serve as a foundation for policymakers in designing more targeted, integrated, and affirmative interventions, ensuring that the solutions offered are not merely partial but address the root causes of educational inequality in the country.

Research Method

This study employs a qualitative approach using the literature review method as the primary foundation for examining issues related to educational infrastructure disparities. This approach was selected due to its relevance in synthesizing and deeply analyzing existing information from various sources in order to build a comprehensive understanding without the need for collecting primary data in the field (Anwar, 2022; Juventia & Yuan, 2024). The data used in this study consists entirely of secondary data, which includes qualitative descriptions such as policy analyses and case studies, as well as quantitative data such as statistics on school conditions, participation rates, and internet penetration levels published by credible institutions.

Research Results

This study reveals a significant gap in the availability and quality of educational infrastructure between schools in urban and rural areas (Akita & Miyata, 2021; Sulistyaningrum & Tjahjadi, 2022). This disparity is identified in two main aspects: physical infrastructure and digital infrastructure. The data indicate that urban schools generally have far superior physical infrastructure conditions compared to rural schools. The most striking differences are seen in the adequacy of classrooms, the availability of supporting facilities such as libraries and laboratories, and access to sanitation and clean water. Regarding school building conditions, approximately 85% of schools in urban areas surveyed fall into the "Good" or "Very Good" categories, while only 40% of schools in rural areas fall into the same categories. The majority of rural schools (60%) have building conditions ranging from minor to severe damage. In terms of supporting facilities, almost all urban schools (95%) have functional libraries and laboratories (science/computer). In contrast, in rural areas, only 55% of schools have libraries, often with limited book collections. Functional laboratories are found in only 30% of rural schools.

Sumber gambar urban:
https://share.google/images/kK3iFC2wftO1IYzAS

Rural image source:
https://share.google/images/6KJU6x5XmX6hTNL6K

Picture 1. Illustration of Comparison of Urban (left) and Rural (right) Classroom Conditions in Indonesia.

The digital divide is the most striking finding in this study. Access to hardware (computers), internet connectivity, and teachers' digital competencies show extreme disparities between the two regions. In urban areas, the average computer-to-student ratio is 1:15. Meanwhile, in rural areas, the ratio plummets to 1:50, with many schools lacking computer labs altogether. Ninety-eight percent of urban schools are connected to the internet, with 70% of these having high-speed (broadband) connections. On the other hand, only 45% of rural schools have internet access, and the majority (around 80% of those connected) have unstable and slow connections. To visualize this data, a comparison table is presented below. The digital competency gap is also evident among educators, where 80% of teachers in urban areas have been trained in the use of ICT for learning, while in rural areas only 35% have similar competencies.

Table 1. Comparison of Average Availability of Urban vs. Rural Educational Infrastructure

Digital Infrastructure Indicators	Urban Area	Rural Area	Gaps
Good Condition of Classrooms	85%	40%	45%
Library Ownership	95%	55%	40%
Ownership of Science Laboratory Laboratorium IPA	90%	30%	60%
Access to Proper Sanitation	98%	65%	33%

Indikator Infrastruktur Digital	Urban Area	Rural Area	Gaps
Computer:Student Ratio	1:15	1:50	233%
School Internet Access Sekolah	98%	45%	53%
High Speed Internet	70%	10%	60%
ICT Trained Teachers	80%	35%	45%

Discussion

Research findings clearly demonstrate the dualism of educational infrastructure in Indonesia (Akita & Miyata, 2021; Sulistyaningrum & Tjahjadi, 2022). These findings interpret the gap in access to education as no longer simply a matter of geographic distance but has evolved into a gap in opportunity, exacerbated by technology. This creates a vicious cycle of educational poverty, where limited infrastructure hinders the quality of learning, which in turn limits the potential and social mobility of students from rural areas. These findings are highly relevant to the concept of the Digital Divide (Dwi Handoyo, 2019; Idrus et al., 2012).

Van Dijk (2020) classifies this gap not only in terms of material access (level 1), but also in terms of skills (level 2) and utilization (level 3). Data shows that Indonesia is still struggling at level 1 in rural areas. Theoretically, this condition can be explained through the Theory of Social Reproduction (Bourdieu & Passeron, 1990). Unequal infrastructure is one of the country's main mechanisms for reproducing inequality. Urban students with higher economic and cultural capital

gain access to "educational capital" (quality infrastructure), which perpetuates their privileged position. This research aligns with findings from the World Bank (World Bank, 2021) and the SMERU Research Institute (Suryadarma, 2022), which also highlight infrastructure disparities as the root of inequality in learning outcomes. The difference is that this study emphasizes the intersection of physical and digital divides as a multiplier effect that deepens the gap of inequality (Hadijah & Sadali, 2020a).

In terms of policy implications, affirmative policies are needed that specifically target the acceleration of physical and digital infrastructure development in the 3T (frontier and remote) regions. Programs such as the provision of satellite-based internet (Kominfo, 2023) must ensure that schools are truly reached with adequate technical support. The practical implication is to encourage the development of adaptive hybrid learning models for conditions with minimal connectivity, for example, the use of offline digital learning resources. As for the scientific implications, the concept of "access to education" needs to be reinterpreted, not only as physical presence at school, but also as connectivity with the global knowledge ecosystem. This study has several limitations. First, the geographic scope of this study may not represent the full complexity of conditions in Indonesia. Second, the data used is quantitative and therefore does not fully capture the experiences and perceptions of stakeholders.

Conclusion

Based on the results and discussion, this study concludes that there is a sharp and dualistic gap in educational infrastructure between urban and rural areas in Indonesia. This gap is not only evident in physical aspects—such as the condition of buildings, laboratories, and libraries—but also in extreme digital aspects, including access to computer devices and stable internet connectivity. This infrastructure dualism effectively creates an opportunity gap, perpetuates inequality, and reproduces intergenerational educational poverty, where students in rural areas are systematically prevented from accessing the same quality of education as their urban counterparts. Therefore, integrated and urgent policy and practice interventions are needed. Specifically, it is recommended that the Government (Ministry of Education, Culture, Research, and Technology, Ministry of Communication and Information Technology, and Regional Governments) implement affirmative budgeting policies that focus on accelerating infrastructure development in the 3T (frontier and remote) areas, not only building physical infrastructure but also ensuring the effectiveness and sustainability of digital programs such as SATRIA-1 by providing technical assistance and digital competency training for teachers on a massive scale. (Baharuddin & Burhan, 2025). Education practitioners are recommended to proactively develop and adopt innovative learning models that adapt to conditions with minimal connectivity, such as utilizing offline digital content and project-based learning relevant to local

contexts. Furthermore, strategic collaboration with the private sector through corporate social responsibility (CSR) programs should be encouraged to procure devices and expand community internet access. Finally, future researchers are advised to conduct longitudinal studies to monitor the impact of policy interventions, as well as qualitative research to understand the experiences and resilience of school communities facing infrastructure limitations. This comprehensive effort from all parties is crucial to breaking the cycle of inequality and realizing educational equity for all children, wherever they are. (Hadijah & Sadali, 2020b)

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