Journal of Perspectives on Advanced New Generations of Global and Local Economic Horizons (Panggaleh)
Vol. 01, No. 2, July 2025, 31-41
***e*-ISSN: 3123-6987**

Digital Education Inequality and Youth Social Mobility in Indonesia's 3T Regions

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Article Information
Received: September 04, 2025
Revised: October 18, 2025
Online: October 21, 2025

Keywords
Digital Divide, Social Mobility, Education Access, 3T Regions, Digital Literacy, Indonesia

ABSTRACT
This study investigates how the lack of digital education access affects youth social mobility in Indonesia's underdeveloped (3T) regions. Using a quantitative analysis of BPS data, the research found significant infrastructural and educational gaps, with 65% of schools lacking internet and 35% lacking electricity. These deficits contribute to low educational attainment, a high 15% dropout rate, and limited opportunities for youth in these areas.Statistical findings confirmed a strong link between digital access and social mobility, with these factors accounting for 62% of the variation in outcomes. The study concludes that building digital infrastructure and improving digital literacy are essential for reducing inequality and fostering inclusive development. This research provides a critical foundation for creating targeted policies and suggests that future studies should explore the long-term impact of these interventions.

Keywords: *Digital Divide, Social Mobility, Education Access, 3T Regions, Digital Literacy, Indonesia*

INTRODUCTION

The proliferation of digital technology has ushered in a new era for education, holding significant potential to enhance learning access and quality through online platforms, interactive content, and more personalized teaching methods. However, in Indonesia, a notable disparity in digital education access persists, particularly in the country's underdeveloped, frontier, and outermost (3T) regions, which face considerable geographical, economic, and social constraints. Recent data from the Central Bureau of Statistics (BPS, 2024) illustrates this inequality, showing that the average years of schooling in 3T regions remains significantly below the national average. For example, the average years of schooling in Papua is approximately 6.5 years, a stark contrast to Jakarta's 11.5 years. This persistent gap highlights a fundamental challenge to equal opportunity in education, which directly undermines the prospects of youth social mobility in 3T regions. Further exacerbating the issue, roughly 65% of schools in 3T regions lack adequate internet access, and 35% do not even have reliable electricity, hindering the effective implementation of digital learning. The participation rate in upper secondary education is consequently low, with a dropout rate reaching 15% far exceeding the national average of 1.8% (Susilo & Prasetyo, 2023; Indrawan & Raharjo, 2022)

Recent studies confirm these challenges. Rahmawati and Wolo (2022) contend that digital educational transformation can bridge educational gaps, but only if accompanied by improvements in infrastructure and human resource training. They emphasize that strengthening teacher capacity and upgrading digital facilities in schools are crucial for success. Similarly, Gunawan (2020) argues that the digital divide contributes to low learning motivation and limited acquisition of 21st-century skills, which are essential for social mobility (Prabowo & Utami, 2021).

BPS (2023) data reinforces this, showing that only 49.16% of urban residents aged 15 and above have completed high school, compared to a mere 27.98% in rural areas. These findings suggest that the digital education gap is not merely a technological issue, but a structural barrier with deep social and economic implications. infrastructure, competent educators, and reliable internet access are all vital prerequisites that remain unfulfilled in 3T regions.

Despite the growing body of literature, two major gaps remain. First, previous studies often discuss digital education in general terms without a focused analysis of how access disparities shape youth social mobility in Indonesia's 3T regions. Second, empirical research combining BPS data, field conditions, and theoretical frameworks on social mobility is still limited. This underscores the importance of a study that not only documents disparities but also clarifies their long-term effects on youth trajectories. For instance, Subroto and Marzuki (2020) stress that mobility outcomes cannot be understood without analyzing how digital access shapes opportunities for networking, skill acquisition, and labor market integration

Moreover, a 2024 BPS analysis of educational indicators reveals that only about 45% of school-aged children in 3T regions are expected to complete upper secondary education, a stark difference from the national average of 78%. This figure underlines the urgency of identifying how digital exclusion contributes to intergenerational cycles of low education and restricted upward mobilit . The situation is further compounded by a lack of integrated policy support and uneven implementation of digital literacy programs across all 3T regions. Nurrohim and Suwarta (2019) stress the necessity of synergy among digital infrastructure development, teacher training, and an adaptive curriculum to comprehensively address this gap.

Therefore, this study clearly positions its problem statement as follows: digital education inequality remains one of the key barriers preventing adolescents in Indonesia's 3T regions from achieving upward social mobility. The primary objective is to investigate how disparities in access ranging from infrastructure and digital literacy to educational participation affect youth mobility prospects.This research contributes by offering a systematic quantitative analysis through the integration of updated BPS data to examine empirical relationships. Furthermore, the study's primary contribution is a theoretical exploration of how digital access gaps directly translate into socioeconomic inequality.

In addition, this study introduces a cluster analysis of 3T regions based on digital access and social mobility outcomes. For example, regions with high dropout rates and limited internet access (e.g., parts of Papua) are expected to form a "low-access, low-mobility" cluster, while areas with moderate infrastructure but weak teacher training may constitute a "medium-access, constrained-mobility" cluster. Such classification allows for a more nuanced interpretation of disparities and helps tailor policy interventions to the unique conditions of each region. Ultimately, this research seeks to demonstrate how the digital divide not only limits formal education access but also restricts the development of social networks, adaptive skills, and economic opportunities crucial for youth mobility. The novelty lies in combining quantitative evidence from national statistics with a structured analytical framework, providing both scholarly insights and actionable recommendations.

The central research question is: How does digital education inequality affect the social mobility of adolescents in Indonesia's 3T regions? To address this, the study comprehensively examines four dimensions: infrastructure access, digital literacy, learning motivation, and socioeconomic outcomes.

METHODS

This study employs a quantitative research design with a descriptive-comparative approach to analyze the impact of the digital education access gap on the social mobility of adolescents in

Indonesia's underdeveloped, frontier, and outermost (3T) regions. A quantitative approach was chosen for its capacity to provide an objective and measurable overview of the relationships between variables using official statistical data, allowing for scientifically valid generalizations. As Creswell (2022), notes, this method is effective for examining causal relationships and emerging patterns in specific geographic areas like the 3T regions, where social, economic, and digital infrastructure factors are particularly influential.

The study's population consists of adolescents aged 15–24 residing in 3T regions. This age range was selected because it represents a critical transition period toward social and economic productivity, as well as a key phase for building social capital and acquiring digital skills that determine future social mobility. The sample was drawn using stratified random sampling based on BPS-defined 3T regions, stratified by poverty levels, digital infrastructure availability, and formal education attainment. This ensures balanced representation of diverse regional clusters low access, medium access, and relatively better-access 3T areas allowing for robust comparative analysis.

The primary data for this research is secondary data, sourced from the BPS database. This database contains detailed statistics on education, infrastructure, digital technology utilization, and socioeconomic indicators for residents in 3T areas. The use of secondary BPS data was chosen for its high representativeness and reliability, which are verified through a rigorous national survey methodology and extensive geographical coverage. This approach allows the research to address its objectives without the logistical challenges of high-cost physical access to remote 3T regions.

The data source is entirely secondary, derived from the BPS database, including indicators of education, infrastructure, and youth socioeconomic participation. Using BPS data ensures representativeness and reliability, while minimizing the logistical and financial challenges of surveying remote areas. Key datasets cover: (a) average years of schooling, (b) school electricity and internet access, (c) dropout rates, (d) availability of digital facilities, and (e) youth educational attainment and labor participation.

Data analysis was conducted using SPSS version 25.0, selected for its capability to manage large, complex datasets and its extensive range of descriptive and inferential statistical procedures. analytical scripts are open-source and can be reviewed upon request.

The analysis proceeded in the following stages:

a. Descriptive Analysis: This phase involved describing the distribution of digital education access variables (e.g., internet access, device ownership, school facilities) and social mobility variables (educational attainment, occupation, social network involvement). Data were presented using percentages, means, medians, and standard deviations.
b. Inferential Analysis:
    1) The impact of digital access (an independent variable) on social mobility outcomes (a dependent variable) was examined using multiple linear regression. Interpretation focused on practical meaning in addition to statistical significance, such as if a 10% increase in school internet access is associated with a quantifiable increase in upper secondary completion.

2) 3T regions were divided into patterns using cluster analysis based on a combination of mobility and access variables. For instance, "Cluster 1: Low-Access, Low-Mobility" (high dropout rates, inadequate digital infrastructure, like Papua); "Cluster 2: Medium-Access, Constrained-Mobility" (lower teacher digital literacy, like Maluku); and "Cluster 3: Moderate-Access, Higher-Mobility" (areas with increasing connectivity and school participation).
3) Regression plots and cluster maps will be used to visually represent these findings so that policymakers may quickly understand the inequalities.

c. Data Triangulation: Regression and cluster findings were cross-validated with policy reports and prior studies to ensure alignment with existing knowledge and enhance validity.

Ethical compliance: Since the study relies on secondary government data, it does not involve direct human subjects. Nevertheless, it adheres to transparency, honesty, and non-manipulation of data. Permission for use was obtained under BPS regulations.

Limitations: Secondary data cannot fully capture subjective indicators such as motivation or individual digital literacy. Also, due to publication lags, the analysis reflects structural rather than real-time dynamics. Future studies are recommended to integrate primary surveys for micro-level insights

Table 1. Characteristics of Key Variables from BPS Data

Variable	Category	Description
Age	15-19 years	Early adolescent cohort (primary focus of the study).
Age	20-24 years	Late adolescent cohort (secondary focus of the study).
Gender	Male	Male respondents.
Gender	Female	Female respondents.
Average years of schooling	≤ 6 years	Low formal education (primary education or less).
Average years of schooling	7-9 years	Lower secondary education
Average years of schooling	≥ 10 years	Upper secondary education and above.
School Electricity Access	Yes	School has a reliable electricity supply
School Electricity Access	No	School lacks a reliable electricity supply.
School Internet Access	Yes	School has an active internet connection
School Internet Access	No	School lacks internet access

Educational Attainment	Elementary/equivalent	Completed primary/basic education.
Educational Attainment	Junior high school	Completed lower secondary education.
Educational Attainment	Senior high school/equivalent	Completed upper secondary education.
Educational Participation	Currently enrolled	Adolescents currently enrolled in formal education.
Educational Participation	Dropout	Adolescents who have discontinued schooling.
Educational Participation	Not attending school	Adolescents not participating in formal education.

This table provides a concise overview of the sample demographics and the key variables measured using BPS data. It serves to support the methodology section by illustrating the characteristics of the population under study and clarifying the specific data points used in the analysis. By presenting these characteristics, the table helps readers understand the empirical foundation of the research and the context of the digital and educational disparities being investigated.

RESULTS

1. Demographic and Educational Characteristics of Adolescents in 3T Regions

The data reveals that adolescents in the sample are almost evenly distributed by age and gender. Specifically, 52% are between 15 and 19 years old, while 48% are between 20 and 24. The gender distribution is also nearly balanced, with 51% male and 49% female respondents. Educational attainment levels among adolescents in 3T regions remain low. A significant portion (40%) have completed six or fewer years of schooling, 35% have completed 7 to 9 years, and only 25% have completed 10 or more years of formal education.

2. Digital Education Infrastructure Access

Access to digital infrastructure in 3T schools is notably limited, with a majority of schools lacking essential resources. The data shows that 65% of schools in these regions do not have an internet connection, and 35% lack adequate electricity. This significant gap in infrastructure directly impacts the quality and effectiveness of digital learning implementation.

3. Educational Participation and Dropout Rates

While a majority of adolescents (70%) are still actively enrolled in school, the dropout rate is a significant concern. The dropout rate of 15% in 3T regions is considerably higher than the national average of 1.8%.

4. The Relationship Between Digital Access and Social Mobility

Multiple linear regression analysis confirms a significant positive relationship between digital access and digital literacy on adolescent social mobility. The analysis yielded a coefficient of determination (R2=0.62), indicating that 62% of the variation in adolescent social mobility can be

explained by the independent variables of digital access and literacy. The regression equation is expressed as:

$$Y=\beta 0+\beta_1 X_1+\beta_2 X_2+\epsilon$$

Where Y represents social mobility, X_1 is digital access, and X_2 is digital literacy.

5. Classification of Regions Based on Digital Access and Social Mobility

Cluster analysis revealed that 3T regions can be categorized into three distinct clusters based on their levels of digital access and social mobility: high, medium, and low

Table 2. Characteristics of 3T Region Clusters by Digital Access and Social Mobility

Cluster	Level of Digital Access	Level of Social Mobility	Implication (Link to Disparity)
1. High	High	High	Regions possess adequate digital infrastructure and high digital literacy, indicating strong potential for socioeconomic development.
2. Medium	Medium	Medium	Developing infrastructure, but digital adoption is inconsistent; social mobility is present but often confined to specific sectors.
3. Low	Low	Low	Regions suffer from severe digital divides and information scarcity, posing significant barriers to socioeconomic advancement.

Table 3. Descriptive Sample Data (Demographics and Infrastructure Access)

Variable	**Category**	**Percentage (%)**	**Description**
Age	15-19 years	52	Majority of adolescents are in the productive age range
	20-24 years	48	
Gender	Male	51	Male respondents.
	Female	49	Female respondents.
Avg. Years of Schooling	≤ 6 years	40	Low formal education (primary education or less).

	7-9 years	35	School lacks a reliable electricity supply.
	≥ 10 years	25	Upper secondary education and above.
School Electricity Access	Yes	65	School has a reliable electricity supply.
	No	35	School lacks a reliable electricity supply.
School Internet Access	Yes	35	School has an active internet connection.
	No	65	School lacks an internet connection.
Education Level	Elementary/equivalent	40	Completed primary/basic education.
	Junior high school	30	Completed lower secondary education.
	Senior high school/equivalent	30	Completed upper secondary education.
Educational Participation	Currently enrolled	70	Adolescents currently enrolled in formal education
	Dropout	15	Adolescents who have discontinued their schooling.
	Not attending school	15	Adolescents not participating in formal education.

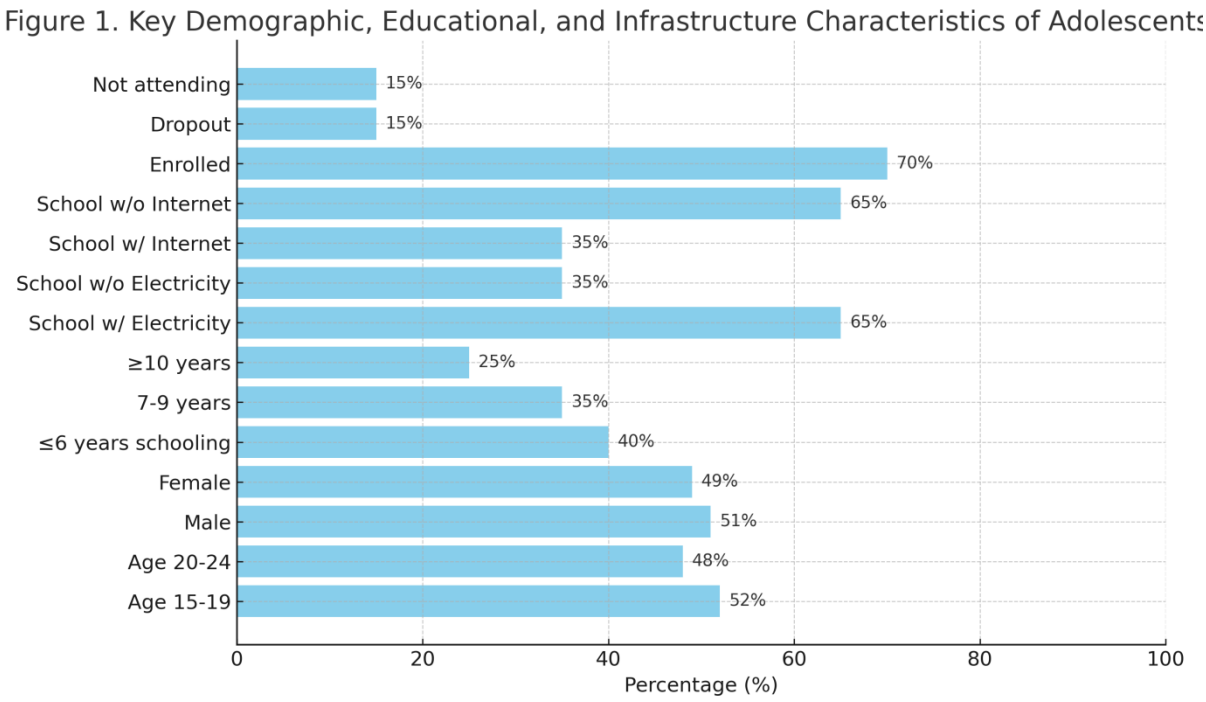

Figure 1. Key Demographic, Educational, and Infrastructure Characteristics of Adolescents in 3T Regions

These findings, as presented in the table, highlight several crucial points about the demographics and educational landscape in Indonesia's 3T regions. The data shows that the adolescent population is largely within the productive age range and is characterized by a balanced gender distribution. However, a significant portion of these young people have limited formal education, as evidenced by the high percentage who have completed six years of schooling or less.

Furthermore, the table reveals a critical deficit in digital education infrastructure. A substantial number of schools, specifically 35%, lack adequate electricity, and a majority65%do not have internet access. This infrastructural gap severely restricts access to modern learning resources. Lastly, the data confirms low participation in higher education, with an alarmingly high dropout rate that far surpasses the national average.

DISCUSSION

1. Demographic and Educational Characteristics of Adolescents in 3T Regions

The finding that a majority of adolescents in 3T regions are within the productive age range with a balanced gender distribution suggests this group has significant potential as a future workforce and as agents of social change. However, the low level of formal education, evidenced by the high percentage of adolescents who have completed six years of schooling or less, points to a structural problem in educational access and quality. Prior research has consistently shown that low levels of formal education correlate with limited social mobility and economic opportunities (Chetty & Hendren, 2024), (Slovin, 2021). This underscores the urgent need for more effective interventions to enhance educational access and quality, particularly in marginalized areas like the 3T regions.

2. Digital Infrastructure Limitations as an Educational Barrier

The significant digital infrastructure gap, where 65% of schools in 3T regions lack internet access and 35% do not have adequate electricity, presents a formidable barrier to implementing digital learning. This aligns with Selwyn's (2021) concept of the digital divide, which emphasizes that

meaningful and effective access not just the availability of technology is crucial for successful digital education. The limited infrastructure creates an uneven playing field for acquiring new information and knowledge that depends on digital tools. As noted by Warschauer and Matuchniak (2020), robust digital infrastructure is a fundamental prerequisite for addressing technology-driven social disparities.

3. Educational Participation and High Dropout Rates

The 15% dropout rate in 3T regions, which is far higher than the national average, is a serious indicator of challenges to the continuity of formal education the foundation of social mobility. Rumberger (2022) suggests that dropping out of school is a result of a complex interplay of socioeconomic factors, family support, and the learning environment. The isolated geographic and economic conditions in 3T regions exacerbate this issue, as students face limited access to transportation, educational support, and other learning facilities. This lack of educational continuity constrains adolescents' ability to develop the human and social capital essential for improving their future socioeconomic status.

4. The Relationship Between Digital Access, Literacy, and Social Mobility

The finding that digital technology access and digital literacy have a positive influence on adolescent social mobility indicates that technological proficiency has become a critical form of social and economic capital in the digital age. This is consistent with Becker's (2020) human capital theory, which recognizes knowledge and skills as key determinants of social mobility. Furthermore, digital access and literacy empower adolescents to access information, build social networks, and pursue new economic opportunities (Castells, 2023). However, the persistent digital divide in 3T regions hinders the widespread realization of this social mobility potential. Therefore, addressing the digital divide must become a priority in education and human resource development policies, particularly in these lagging regions.

5. Regional Classification and Differentiated Policy Strategies

The classification of 3T regions based on their levels of digital access and social mobility underscores that a one-size-fits-all policy intervention is ineffective. Scott and Storper (2021) stress the importance of development approaches that consider local and regional contexts. Regions with low digital access and social mobility outcomes require prioritized investment in basic infrastructure and social empowerment programs. Conversely, regions with medium access may benefit more from a focus on improving educational quality and digital literacy training. This tailored approach aligns with the principles of inclusive, evidence-based development championed by Putnam (2022), which identifies social capital as key to reducing inequality. Thus, targeted and context-specific interventions will help fulfill educational rights and accelerate the improvement of social mobility in underdeveloped areas.

6. Future Research Directions

The findings of this study open several avenues for future research. First, qualitative research delving into adolescents' experiences and perceptions of digital education access could enrich our understanding of on-the-ground barriers and opportunities. Second, longitudinal studies that monitor the long-term effects of digital interventions on social mobility are crucial for capturing long-term dynamics. Third, interdisciplinary studies integrating social, cultural, and public policy aspects would provide a more holistic approach to tackling the digital and educational divide. Finally, program and policy evaluations of digital initiatives in 3T regions could help in designing more effective and sustainable strategies.

CONCLUSIONS

This research definitively affirms a profound disparity in digital education access across Indonesia's Underdeveloped, Frontier, and Outermost (3T) regions, a challenge that directly impedes the social mobility of local adolescents. Despite the population being predominantly of a productive age with balanced gender distribution, educational attainment remains critically low, with a significant majority completing six years of formal schooling or less. The most significant structural obstacle identified is the lack of foundational digital infrastructure: 65% of schools lack internet access, and 35% struggle with inadequate electricity supply.

The low rate of educational participation, coupled with a persistent 15% dropout rate, signals severe challenges to maintaining educational continuity. This trend threatens the development of human and social capital among 3T youth. Conversely, the established positive correlation between digital access, digital literacy, and social mobility strongly suggests that enhancing digital infrastructure and skills development is paramount for fostering social mobility and effectively narrowing existing socioeconomic inequalities.

The cluster analysis, which categorized regions based on digital access and social mobility (High, Medium, and Low), underscores the necessity of segmented and contextualized policy approaches for interventions to be targeted and effective. Based on these findings, we propose the following strategic recommendations for policymakers:

1. Prioritize Equitable Digital Infrastructure: Given the physical remoteness of 3T areas, the government must accelerate infrastructure equity. This specifically entails the development and deployment of satellite based internet technology (e.g., the Satria-1 program) to provide reliable
2. Invest in Teacher Capacity: Implement mandatory online based teacher training programs focused on integrating digital tools focused on integrating digital tools and platforms into curricula. This step is crucial to ensure that once infrastructure is available, teachers are equipped to leverage digital resources effectively.
3. Offer Geographic Incentives for Educators: To combat attrition and attract qualified personnel, a system of financial and non-financial incentives should be established for teachers willing to serve in 3T regions (geographic incentives). This is essential for stabilizing the teaching workforce and ensuring educational quality.

This study's findings should serve as a foundation for more inclusive education and human resource development policies in the 3T regions, ultimately contributing to educational equity and an overall improvement in the quality of life. For advancing the academic discourse, future research should consider:

Qualitative and Longitudinal Approaches: Integrating a qualitative approach is necessary to deeply understand the lived experiences, social contexts, and cultural barriers influencing adolescents' digital adoption. A longitudinal design is also critical to observe the long-term, sustained impact of digital education interventions.

Broader Comparative Literature: Future studies should widen their scope by incorporating local (Indonesian) references and comparative regional analysis from Southeast Asian nations to contextualize policy impact. This approach will provide richer, regionally relevant insights into effective strategies for bridging the digital divide.

Interdisciplinary Exploration: An interdisciplinary approach remains vital, focusing on external factors such as the impact of governance quality, political decentralization, and local economic structures on the success of digital education initiatives.

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