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Inter-Provincial Disparities in Students' ICT Use in Indonesia: Insights for Digital Education Management

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ABSTRACT

Digital transformation in education requires equitable student access to information and communication technology (ICT), yet conditions differ between regions. This study analysed inter-provincial disparity in ICT use among students in Indonesia and discussed its potential implications for digital education management. It was a descriptive analysis of secondary, aggregate provincial statistics from the 2025 Education Statistics, based on the March 2025 National Socio-Economic Survey (Susenas). Three indicators for students aged 5–23 years were examined: use of mobile phones, computers or laptops, and the internet. Descriptive statistics comprised the mean across provinces, standard deviation, minimum, maximum, and range. Disparity was largest for internet use (range 84.18 percentage points; standard deviation 16.32), followed by mobile phone use (76.48; 14.76) and computer or laptop use (35.51; 6.98). Mobile phone and internet data covered 38 provinces, whereas computer or laptop data covered 37 because no value was available for Papua Pegunungan. DI Yogyakarta ranked highest on all three indicators, and the lowest values were concentrated in the Papua region, suggesting that disparities cluster in specific regions. Computer or laptop use was low in nearly every province and showed the greatest relative dispersion. Interpreted through the UNESCO Six Pillars for the Digital Transformation of Education, the findings suggest that planning should be regionally differentiated and should treat devices separately from connectivity, given the differing types of devices required for different learning activities. District-level data are needed to confirm these implications.

Keywords: *Digital Divide, Digital Education Management, ICT Use, Provincial Disparity, Students*

INTRODUCTION

Digital transformation affects education systems at several levels at once. It changes how resources are allocated, how teaching is organised, and how learning opportunities are distributed among students (Sharma et al., 2025; Timotheou et al., 2023). Access to devices, however, does not by itself improve learning. A systematic review of 51 studies on the integration of information and communication technology (ICT) in secondary schools reported that the benefits of technology came with persistent difficulties in teacher professional development, pedagogical and technological knowledge, and the maintenance of resources (Msafiri et al., 2023). Analysis of PISA 2018 data showed that ICT access at school and at home was among the most influential predictors of whether students used technology for educational purposes (Silva et al., 2024). A meta-analysis of 48 studies found that the association between digital device use and adolescents' academic performance was positive when devices were used for educational purposes but negative when they were used for entertainment or gaming (Wang et al., 2024). A study of an AI-supported teaching prototype in early childhood education, framed as a question of educational management, reached a similar conclusion. Its authors reported that the effectiveness of the technology depended on equitable access and sustained teacher professional development (Oshinowo et al., 2025). Taken together, these studies suggest that ICT use should be treated not as an end in itself but as information on which educational management decisions can be based.

The digital divide has long been understood as more than the difference between people who are connected and people who are not. van Dijk (2005) explained digital inequality through unequal resources, which produce differences in motivation, material access, skills, and usage. Hargittai (2002) described a second-level divide, in which people who are already online differ in their ability to use the internet effectively. van Deursen and Helsper (2015) added a third level concerned with the tangible outcomes that people obtain from their use. A recent systematic review confirmed that current research still treats the divide as a matter of disparities in access, usage, and outcomes, and found education to be the factor most often linked to it (Lythreatis et al., 2022). The present study adopts this multidimensional view while recognising that the data analysed here describe only one part of it, namely students' use of devices and the internet.

International evidence consistently shows that digital inequality among students is multidimensional and is shaped by socio-economic conditions rather than by the availability of technology alone. In Europe, 5.4% of school-aged children were found to be digitally deprived, and the children most affected lived with low-educated parents or in poverty (Ayllón et al., 2023). In Ireland, one in six higher education students came from an area with poor broadband coverage, with large differences across regions and institutions (Cullinan et al., 2021). Differences

also appear beyond access. Zhao et al. (2022) reported that rural middle school students in China showed lower behavioural engagement in e-learning than their urban peers, and Youssef et al. (2022) found that digital skills were associated with better academic performance among French university students. Pierce and Cleary (2024) documented substantial disparities in the use of computers and the internet by students at home and at school in the United States. Survey evidence from students in two higher education institutions likewise links internet use to better academic performance and more independent learning (Agoi et al., 2025). Such benefits, however, presuppose that students are connected in the first place.

In Indonesia, the question is shaped by geography. Education is delivered across an archipelago in which provinces differ widely in infrastructure and public service capacity, so national averages can conceal large regional differences. Rahma and Kartiasih (2024) analysed panel data for 34 provinces over the period 2015–2021 and found that ICT indicators and transport infrastructure were related to educational inequality. Their study treated educational inequality as the outcome and infrastructure as the explanation. It did not describe how students' own use of mobile phones, computers, and the internet varies from one province to another, and it did not consider what such variation means for the management of education. The present study addresses both matters with the most recent national survey data available.

Official statistics show why the distinction between devices matters. The 2025 Education Statistics, published by the Central Bureau of Statistics (Badan Pusat Statistik, BPS) from the March 2025 National Socio-Economic Survey (Susenas), report that 85.78% of students aged 5–23 years had used a mobile phone and 83.80% had used the internet in the previous three months, whereas only 19.80% had used a computer or laptop (BPS, 2025b, 2025a). The three indicators reflect different functional capabilities. Mobile phones support communication and basic access, internet use connects students to online resources, and computers or laptops support productive and more complex learning tasks. A disparity in each of these dimensions therefore carries different implications for educational planning. The same publication shows a gap between urban and rural areas: computer or laptop use stood at 24.90% in urban areas against 12.12% in rural areas, and internet use at 87.07% against 78.88% (BPS, 2025b). This is consistent with evidence that unequal technological resources limit students' opportunities in education (Pierce & Cleary, 2024). Urban–rural classification, however, captures only one axis of inequality. Provincial analysis captures geographic and administrative variation that national urban–rural aggregates may obscure, which matters particularly in an archipelagic country.

The management perspective of this study rests on the Six Pillars for the Digital Transformation of Education, a common framework developed by the Digital Transformation Collaborative and published by UNESCO (Atis et al., 2024). The framework treats digital transformation as a systemic process built on

six pillars. Coordination and leadership concerns governance and the alignment of actors. Connectivity and infrastructure concerns access to networks and devices. Cost and sustainability concerns financing and maintenance over time. Capacity and culture concern the skills and attitudes of learners and educators. Content and solutions concern the relevance of learning resources and platforms, and data and evidence concern the use of information in planning and monitoring. The framework was selected because it brings infrastructure, capacity, content, and governance together in a single systemic structure, which suits educational management in a decentralised setting such as Indonesia, and because it was designed to help decision-makers assess needs and set priorities. In this study it serves as an interpretive lens for the findings rather than as a model to be tested.

The literature reviewed above shows that the digital divide in education is multidimensional, that access to a device is not equivalent to effective use of it, and that management decisions on infrastructure, devices, and support need empirical grounding at the regional level. For Indonesia, what is missing is a current description of how students' use of mobile phones, computers or laptops, and the internet differs across all provinces, interpreted for its relevance to educational management rather than as an explanation of causes or learning outcomes. This study therefore aims to analyse inter-provincial disparity in ICT use among students in Indonesia using March 2025 Susenas data, and to discuss the potential implications of that disparity for digital education management through the Six Pillars framework. Three questions guide the analysis: (1) How does ICT use among students vary across provinces in Indonesia? (2) What are the patterns and magnitudes of disparity across the three indicators? (3) What potential implications do these disparities have for digital education management?

The study makes two contributions. Empirically, it provides a province-level description of device-specific and internet use among Indonesian students based on current national data. Conceptually, it links these disparities to the management responsibilities set out in the Six Pillars, showing how descriptive usage data can support needs mapping and priority setting. Because the analysis is descriptive, the managerial implications are presented as potential implications to be examined with further data, not as conclusions about causes. The article proceeds with the methodology, followed by the results and discussion organised around the research questions, and closes with the conclusion.

RESEARCH METHODOLOGY

This study used a descriptive quantitative design based on secondary analysis of aggregate provincial statistics (Creswell & Creswell, 2023). The data came from the 2025 Education Statistics published by the Central Bureau of Statistics (Badan Pusat Statistik, BPS), which reports results from the March 2025 National Socio-Economic Survey (Susenas) (BPS, 2025b, 2025a). Susenas was selected because it is the national household survey that supplies the same ICT indicators for every

province from one questionnaire and one reference period. Combining administrative or sectoral sources would have introduced differences in definitions and coverage that complicate comparison between provinces. The March 2025 round covered a sample of 345,000 households in all 38 provinces and 514 districts and cities. The households were a new, non-panel sample drawn from selected census blocks by systematic sampling, with implicit stratification by the education level of the household head, and field enumeration took place from 8 to 27 February 2025 (BPS, 2025a).

The analysis covered three indicators reported for students aged 5–23 years: the percentage of students who used a mobile phone, a computer or laptop, and the internet. The indicators were analysed separately because each represents a different form of technology use, and none can substitute for another. As defined by BPS, use refers to having used the device or service within the previous three months. The indicators therefore show whether students used a technology in that period. They do not show whether students owned a device, how often they used it, or for what purpose. The age range of 5–23 years is the range for which BPS reports student ICT use in the Education Statistics, and it was retained so that the findings remain comparable with the published national figures. ICT use and educational needs differ considerably between young children and young adults. The analysis treats students as a single group, which is acknowledged as a limitation. The indicators were not intended to measure overall digital readiness. They describe the extent of device and internet use, which is one aspect of access relevant to digital education.

The provincial values were taken from the BPS tables and compiled in one worksheet, in which province names, indicator labels, and units of measurement were standardised. Data were available for 38 provinces on mobile phone use and internet use, but for only 37 provinces on computer or laptop use, because no value was available for Papua Pegunungan. This missing value was not replaced with zero or with an estimate. The province was excluded from the computer or laptop statistics and retained in the other two, so each indicator was analysed on all available observations. The difference in the number of provinces should therefore be kept in mind when the three indicators are compared.

For each indicator, the analysis calculated the minimum, maximum, range, arithmetic mean across provinces, and standard deviation, computed as the population standard deviation over all available provincial values. The minimum and maximum identified the provinces with the lowest and highest percentages, and the range expressed the distance between them. The standard deviation described the dispersion of values around the mean. To compare relative dispersion across indicators with different averages, the coefficient of variation (standard deviation divided by the mean, multiplied by 100) and the ratio of the maximum to the minimum value were also calculated. The arithmetic mean across provinces gives every province equal weight regardless of its population. The official BPS national

figure is estimated from the survey and reflects the distribution of students across the country. The two measures are therefore not interchangeable: the unweighted mean suits the assessment of disparity between provinces, whereas the national figure suits the assessment of overall coverage. The analysis remained descriptive. Minimum and maximum values are sensitive to extreme cases and do not describe the whole distribution. Measures such as the Gini coefficient or Theil index, quartile analysis, kernel density estimation, and spatial analysis could characterise it more completely, and they are suggested for future research.

RESULT AND DISCUSSION

Overview of ICT Use and Interpretive Boundaries

The provincial results differ from the national picture in a consistent direction. The unweighted means across provinces were lower than the official national percentages for all three indicators: 80.00% against 85.78% for mobile phone use, 76.67% against 83.80% for internet use, and 16.38% against 19.80% for computer or laptop use (BPS, 2025b). The national figures are estimated from the survey and reflect where students live, whereas the provincial mean gives each province equal weight. The gap is therefore consistent with low-use provinces pulling the unweighted mean down, although the present data cannot confirm this. The two measures answer different questions. The provincial mean describes how far provinces differ from one another, and the national figure describes overall coverage.

The indicators describe whether students used a device or service in the previous three months. They do not measure ownership, connection quality, affordability, digital skills, or learning outcomes, and the provincial aggregates do not show variation inside a province. The analysis below describes disparities in use and treats any explanation of their causes as a hypothesis for later research. Computer or laptop data were available for 37 provinces because no value was reported for Papua Pegunungan, and the other two indicators covered 38 provinces.

Mobile Phone Use across Provinces

Mobile phone use averaged 80.00% across the 38 provinces, with a standard deviation of 14.76 percentage points and a range of 76.48 percentage points (Table 1). The range is nearly as large as the mean, which indicates substantial heterogeneity. The coefficient of variation was 18.45%, and the highest province recorded a value 5.7 times that of the lowest. The range is strongly influenced by a single province, however. Papua Pegunungan recorded 16.40%, while the next lowest values were 50.66% in Papua Tengah and 51.20% in Papua Selatan. Without Papua Pegunungan, the range would be 42.22 percentage points, which is still wide.

Table 1 Descriptive Statistics of ICT Use by Students Across Provinces

Indicator	Provinces (n)	Mean (%)	SD (pp)	Min (%)	Max (%)	Range (pp)	CV (%)	Max/min ratio
Mobile phone use	38	80.00	14.76	16.40	92.88	76.48	18.45	5.66
Computer/laptop use	37	16.38	6.98	5.85	41.36	35.51	42.61	7.07
Internet use	38	76.67	16.32	9.33	93.51	84.18	21.29	10.02

Note. SD = population standard deviation over all available provincial values; CV = SD divided by the mean × 100. Computer/laptop data for Papua Pegunungan were unavailable and were not treated as zero.

Source: Processed by the researchers from Badan Pusat Statistik (2025)

The highest values were not concentrated in one part of the country. DI Yogyakarta recorded 92.88%, followed by Kepulauan Bangka Belitung (92.18%) and Bali (92.03%), and Nusa Tenggara Barat and DKI Jakarta also exceeded 90%. These provinces lie on different islands, so high mobile phone use was not specific to one region. The lowest values were clustered. Papua Pegunungan, Papua Tengah, and Papua Selatan occupied the bottom three positions, which suggests that low mobile phone use is concentrated in the Papua region rather than scattered randomly. This pattern is consistent with the association that Rahma and Kartiasih (2024) found between ICT and transport infrastructure and educational inequality across 34 provinces, although the present data do not test that link. Programmes that rely on mobile devices to reach students would meet a much lower baseline in these three provinces.

Computer or Laptop Use across Provinces

Computer or laptop use averaged 16.38% across the 37 provinces with data, with a standard deviation of 6.98 percentage points and a range of 35.51 percentage points. DI Yogyakarta recorded the highest value (41.36%), which is 2.53 times the provincial mean. DKI Jakarta (31.02%) and Bali (26.35%) followed. The lowest values were recorded in Papua Tengah (5.85%), Maluku Utara (6.80%), and Papua Barat (7.37%). Even the highest province recorded a value below half of its students.

The standard deviation and range are the smallest of the three indicators, but this reflects the low level of the indicator and not an even distribution. When dispersion is expressed relative to the mean, computer or laptop use shows the highest variation, with a coefficient of variation of 42.61% against 18.45% for mobile phones and 21.29% for the internet. The computer indicator is therefore low in almost every province, which points to a national-level device issue, and it is also relatively unequal between provinces. Both findings matter for planning. Provinces at the top of the distribution still fall short of universal use, while provinces at the bottom start from very low levels.

Internet Use across Provinces

Internet use had the widest absolute range of the three indicators at 84.18 percentage points, with a mean of 76.67% and a standard deviation of 16.32 percentage points. DI Yogyakarta recorded 93.51%, followed by Jawa Tengah (90.89%) and Kepulauan Bangka Belitung (90.68%), and Kepulauan Riau and Bali recorded values close to 90%. At the other end, Papua Pegunungan recorded 9.33%, followed by Papua Tengah (42.92%), Papua Selatan (44.87%), and Papua (58.57%). The highest province recorded a value about ten times that of the lowest. Excluding Papua Pegunungan, the range would still be 50.59 percentage points, the widest of the three indicators.

This result matters because connectivity is a precondition for most online learning platforms, whereas a mobile phone can support some activities offline. The data also show that low values coincided in the same provinces. Papua Tengah recorded the second-lowest value for mobile phone use (50.66%), the second-lowest for internet use (42.92%), and the lowest for computer or laptop use (5.85%) among provinces with data. At the provincial level, students in such provinces therefore appear to face constraints on all three indicators at once.

Comparison of Disparity across the Three Indicators

The three measures of disparity rank the indicators differently (Table 1). Internet use had the largest range and the largest max/min ratio. Computer or laptop use had the largest coefficient of variation, and mobile phone use was the most evenly distributed on every measure. Table 2 lists the extreme provinces for each indicator. DI Yogyakarta ranked first on all three, and Papua Pegunungan ranked last on mobile phone and internet use.

Table 2 Provinces with the Highest and Lowest Percentages of ICT Use

Indicator	Highest	Percentage	Lowest with Available Data	Percentage
Mobile phone	DI Yogyakarta	92.88%	Papua Pegunungan	16.40%
Computer/laptop	DI Yogyakarta	41.36%	Papua Tengah	5.85%
Internet	DI Yogyakarta	93.51%	Papua Pegunungan	9.33%

Source: Processed by the researchers from Badan Pusat Statistik (2025)

Two patterns interact. High aggregate levels of mobile phone and internet use conceal large differences between provinces, and the low aggregate level of computer or laptop use is a system-wide shortfall that also varies considerably in relative terms. Educational management therefore faces two separate gaps. One is an access gap, which means ensuring that students in every province can connect.

The other is a device gap, which means ensuring that students have devices suited to different kinds of learning activity.

Potential Implications for Digital Education Management

The findings support four main implications, which are presented first and then elaborated through the Six Pillars framework (Atis et al., 2024). First, planning for infrastructure and ICT support needs a regional, needs-based approach, because one uniform policy would match the needs of high-use and low-use provinces unequally. Second, device provision should be planned as a separate component and not treated as a by-product of connectivity. Mobile phones are well suited to consuming content and to communication, whereas writing, programming, and creating presentations are easier on a computer or laptop. Managers should therefore distinguish access devices from production devices, and either design activities that work on both or provide production devices where an activity requires them. The gap between a provincial mean of 80.00% for mobile phones and 16.38% for computers shows that this distinction cannot be ignored. Third, priority setting should not rely on provincial rankings alone, since provincial data cannot show which districts or schools are worst affected. The three lowest provinces are all in Papua, but this does not mean that every district in them is equally affected, and within-province variation may be as large as the variation between provinces. Fourth, programme evaluation should separate input indicators (such as devices supplied or bandwidth available), access indicators (such as the share of students online or the device-to-student ratio), utilisation indicators (such as frequency and type of ICT use in learning), and outcome indicators (such as digital skills and learning results). Without this separation, a programme could be judged a success simply because more devices were delivered.

Table 3 shows how each pillar relates to the findings. It separates what the data directly support from the implications derived from them and from the evidence still needed.

Table 3 Findings, Derived Implications, and Evidence Needed by Pillar

Pillar	Finding Supported by the Data	Derived Implication	Evidence Still Needed
Connectivity and infrastructure	Internet use ranged from 9.33% to 93.51% (range 84.18 pp)	Low-use provinces should be prioritised for connectivity assessment	Network coverage, cost, electricity, and school connectivity at district level
Cost and sustainability	Computer/laptop use was low everywhere (mean 16.38%) and relatively unequal (CV 42.61%)	Device provision is a national planning issue that also needs regional targeting	School device inventories, device-to-student ratios, maintenance and replacement costs

Pillar	Finding Supported by the Data	Derived Implication	Evidence Still Needed
Capacity and culture	Use indicators do not measure skills	Training should not assume that high use means high competence	Data on digital skills of students and teachers
Content and solutions	Provinces differ in the device and connectivity available to students	Learning content should work across device and connectivity conditions	Accessibility of existing platforms under local conditions
Coordination and leadership	The same provinces rank high, or low, across all three indicators	Central, regional, and institutional actors need coordinated, region-specific targets	Governance and coordination factors behind provincial differences
Data and evidence	Computer/laptop data were missing for one province; indicators omit quality and purpose	Planning needs more granular and more complete data	District and school-level data on device quality, reliability, and purpose of use

Source: Analysed by the researchers (2025)

On connectivity and infrastructure, the wide internet range suggests that managers in low-use provinces should first establish where the constraint lies, whether in network coverage, affordability, device availability, or electricity. Such connectivity audits could then guide targeted action, such as school-based connectivity where household use is low or subsidised data where cost is the main barrier. The audits are a suggested next step and not a conclusion of this study. On cost and sustainability, the low and relatively unequal computer figures call for resource planning that covers a stock-take of devices in schools, an estimate of what a minimum device-to-student ratio would cost, plans for maintenance and replacement, and consideration of financing options such as leasing or partnerships. The data identify where to look but cannot yet determine budgets. On capacity and culture, the indicators cannot be read as proxies for skills. Training should be planned with device conditions in mind and should draw on future data on the digital skills of students and teachers.

On content and solutions, the differences in device and connectivity conditions suggest that digital learning content should be usable in several access modes: offline-capable for low-connectivity areas, optimised for mobile phones where they are the main device, and computer-based for activities that need one. Managers should check whether current platforms work under the conditions that prevail in each province. On coordination and leadership, the consistent position of DI Yogyakarta at the top and of the Papua provinces at the bottom suggests that the causes of provincial differences deserve study, including governance factors such

as the commitment of local governments, school leadership, and coordination between agencies. This study does not test such factors. On data and evidence, the findings show gaps that limit management: one province had no computer data, and none of the indicators capture device quality, connection reliability, or purpose of use. Educational managers should therefore press for data at the district and school levels so that interventions can be targeted.

The results support earlier evidence that student access to technology is unevenly distributed and that the unevenness follows geography. Ayllón et al. (2023) found that digital deprivation among school-aged children differed greatly between European countries, and Cullinan et al. (2021) reported large geographical disparities in broadband coverage for higher education students in Ireland. Pierce and Cleary (2024) likewise documented substantial disparities in the use of computers and the internet among students in the United States. The provincial pattern found here, with a spread of more than 84 percentage points in internet use, adds an Indonesian case in which the gaps appear within a single country and are concentrated in particular regions. The finding that internet use was the most unequal indicator also aligns with the emphasis that Rahma and Kartiasih (2024) placed on improving internet access to reduce educational inequality.

The results extend earlier work in three ways. First, Rahma and Kartiasih (2024) studied ICT and transport infrastructure as explanations for educational inequality, whereas this study describes how students' own use of three separate technologies varies across provinces in 2025. Second, the device-specific results are consistent with Wang et al. (2024), who showed that the relationship between device use and adolescents' academic performance depends on the type and purpose of use. The present data show that device type is already a major source of difference, since use of computers and laptops was far lower and far more unequal in relative terms than use of mobile phones, but they cannot speak to purpose. Third, Silva et al. (2024) identified ICT access at school and at home as one of the strongest predictors of educational ICT use, and Msafiri et al. (2023) reported that resource maintenance and teacher professional development are persistent obstacles to ICT integration. Provinces with low use are likely to start from a weaker base on both points, although the present data do not test this. Oshinowo et al. (2025) similarly concluded that the benefits of AI-supported teaching depend on equitable access and teacher development, and the present provincial gaps suggest that such tools would meet very unequal conditions across Indonesia.

The results qualify two points in earlier work without contradicting them. Zhao et al. (2022) and the BPS urban–rural statistics place the main divide between rural and urban students. In the BPS figures, internet use differed by 8.19 percentage points between urban and rural areas, and computer or laptop use was about twice as high in urban areas (24.90% against 12.12%). The provincial results show much larger differences, namely 84.18 percentage points for internet use and a seven-fold difference for computers or laptops. An urban–rural comparison alone would

therefore understate inter-regional disparity in an archipelagic country. In addition, the survey evidence of Agoi et al. (2025) that the internet can democratise access to learning assumes that students are online, which the provincial data show is far from uniform. Taken together, the results support earlier findings that student ICT access is unequal and geographically patterned, extend them by showing device-specific and province-level disparities in Indonesia, and qualify, rather than contradict, studies that emphasise rural–urban differences or the benefits of internet use. No finding in this study directly contradicts the cited research. Where the results diverge, it is in scale and emphasis, and the descriptive design cannot show whether the disparities affect learning outcomes.

CONCLUSION

This study analysed inter-provincial disparity in ICT use among Indonesian students aged 5–23 years, using March 2025 Susenas data on mobile phone, computer or laptop, and internet use. The disparities were substantial and differed by indicator. Internet use ranged from 9.33% in Papua Pegunungan to 93.51% in DI Yogyakarta, a range of 84.18 percentage points. Mobile phone use ranged from 16.40% to 92.88%, a range of 76.48 percentage points, and computer or laptop use ranged from 5.85% in Papua Tengah to 41.36% in DI Yogyakarta, a range of 35.51 percentage points. Computer or laptop use was low in almost every province (provincial mean 16.38%) and showed the greatest relative dispersion (coefficient of variation 42.61%). The lowest values on all indicators were concentrated in the Papua region, whereas DI Yogyakarta ranked first on all three.

These results indicate that inter-provincial disparities in ICT use are multifaceted and that digital education planning needs to differ by region and by device type. The study did not examine management processes directly. The findings nevertheless provide an empirical basis for deciding where to direct management attention and resources. Read through the Six Pillars framework, they suggest that connectivity should be assessed first in low-use provinces, that device provision should be planned as a component separate from internet access, and that priorities should be set through coordination among central government, regional governments, and educational institutions. Evaluation should also separate input, access, utilisation, and outcome indicators, so that the supply of devices is not mistaken for educational improvement.

The study has several limitations. The data were aggregated at the provincial level and therefore did not show variation among districts, institutions, or households. The indicators measured use within the previous three months, not device ownership, connection quality, affordability, digital competence, or learning outcomes. The 5–23 age range combines very different educational stages, and computer or laptop data were unavailable for Papua Pegunungan. Future research should combine ICT use data with socio-economic indicators, telecommunications infrastructure, device availability at home and at school, and the digital competence

of students and teachers. Analysis at district or school level, disaggregated by age group, would reveal variation that provincial data conceal. Where suitable data exist, inferential analysis and inequality measures such as the Gini coefficient or Theil index could test the relationships suggested here and quantify the disparities more precisely.

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