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Bridging the Digital Divide in Education: Disparities in Google Classroom Utilization and Technical Challenges Among Urban and Rural Teachers in Banten Province, Indonesia

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ABSTRAK

Pembelajaran daring telah menimbulkan tantangan besar bagi siswa dan guru di Indonesia, terutama akibat kesenjangan digital, yang mencerminkan disparitas akses terhadap Teknologi Informasi dan Komunikasi (TIK). Kesenjangan ini terlihat jelas di Provinsi Banten, di mana daerah perkotaan seperti Kota Tangerang, Kota Tangerang Selatan, dan Kota Serang memiliki infrastruktur digital yang lebih maju dibandingkan daerah pedesaan seperti Lebak dan Pandeglang, yang masih menghadapi keterbatasan akses internet, ketersediaan perangkat yang tidak memadai, serta dukungan teknis yang kurang. Penelitian ini menganalisis perbedaan signifikan dalam faktor pendukung pembelajaran digital, termasuk koneksi jaringan, kendala teknis, infrastruktur sekolah, serta penggunaan Google Classroom di kalangan guru sekolah menengah di daerah perkotaan dan pedesaan di Banten. Sebanyak 395 guru berpartisipasi dalam survei daring yang mencakup data demografis dan 22 item kuesioner. Data dianalisis menggunakan statistik deskriptif dan uji t, yang menunjukkan bahwa kendala teknis serta penggunaan Google Classroom secara signifikan berbeda antara guru di perkotaan dan pedesaan. Hasil penelitian ini memberikan wawasan penting bagi pemangku kepentingan pendidikan, terutama pemerintah dan sekolah, dalam merancang dukungan teknis yang lebih terarah serta program pelatihan berkelanjutan bagi guru. Perhatian khusus diperlukan bagi daerah pedesaan seperti Lebak dan Pandeglang, di mana guru masih mengalami kesulitan dalam mengadopsi teknologi pembelajaran digital. Dengan alokasi sumber daya pendidikan yang lebih strategis dan implementasi kebijakan berbasis wilayah, penelitian ini menekankan perlunya menjembatani kesenjangan digital dan memastikan pemerataan akses terhadap pendidikan berbasis teknologi di Banten dan Indonesia.

ABSTRACT

Online learning has posed significant challenges for students and teachers in Indonesia, particularly due to the digital divide, which reflects disparities in access to Information and Communication Technologies (ICT). This divide is evident in Banten Province, where urban areas such as Tangerang City, South Tangerang City, and Serang City benefit from more advanced digital infrastructure compared to rural regions like Lebak and Pandeglang, which still face limited internet access, inadequate device availability, and insufficient technical support. This study examines the significant differences in key digital learning support factors, including network connectivity, technical challenges, school infrastructure, and Google Classroom usage among secondary school teachers in urban and rural Banten. A total of 395 teachers participated in an online survey comprising demographic data and 22 questionnaire items. The data were analyzed using descriptive statistics and t-tests, revealing that technical issues and Google Classroom usage significantly differed between urban and rural teachers. The findings provide valuable insights for educational stakeholders, particularly governments and schools, in designing targeted technical support and sustained teacher training programs. Special attention is needed for rural areas like Lebak and Pandeglang, where teachers still struggle with the adoption of digital learning technologies. By strategically allocating educational resources and implementing region-specific policies, this study emphasizes the need for bridging the digital divide and ensuring equitable access to technology-enhanced education across Banten and Indonesia.

1. INTRODUCTION

The COVID-19 pandemic has accelerated a major transformation in global education, driving the rapid and widespread adoption of digital technologies (Sjahrudin et al., 2022; Koumiti et al., 2024). This shift has led to the extensive use of online learning platforms, video conferencing tools, and digital applications to sustain educational activities during lockdowns and social restrictions (Gulyanto & Sari, 2023). Innovations such as augmented reality and virtual reality have further enhanced student engagement, creating immersive learning experiences across various disciplines (Koumiti et al., 2024). This phenomenon aligns with disruptive innovation

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theory, wherein technology integration not only reshapes traditional learning models but also redefines the value of education (Manocha et al., 2022). In response, educational institutions have adapted by incorporating digitalization into academic activities, with some universities transitioning entirely to online teaching. This digitalization trend is expected to persist beyond the pandemic, with hybrid learning models becoming increasingly prevalent across educational levels (Haleema et al., 2022).

The COVID-19 pandemic has accelerated the shift to online education, exacerbating existing digital disparities and posing significant challenges for both students and educators (Ceviker & Gezer, 2023; Iftikhar et al., 2023). Socioeconomic status, geographical location, and access to technology have emerged as key determinants in widening this gap (Ceviker & Gezer, 2023; Esteban & Cruz, 2021). Studies in Pakistan, the Philippines, and Nepal indicate that students from rural areas and low-income families face greater barriers to effective online learning (Iftikhar et al., 2023; Esteban & Cruz, 2021; Baral, 2022). Digital inequality extends beyond access to technological devices, encompassing disparities in digital literacy among both students and educators. Enhancing information and communication technology (ICT) proficiency is crucial for maximizing the effectiveness of online learning (Ceviker & Gezer, 2023). While online education offers a viable alternative during emergencies, it also risks deepening educational inequities, particularly for those lacking access and digital competencies (Baral, 2022). Addressing this issue requires strategic interventions from governments and educational institutions. Investments in infrastructure, targeted training programs for educators, and support for vulnerable student populations are essential to fostering a more inclusive online learning ecosystem and ensuring equitable access to quality education (Baral, 2022; Ceviker & Gezer, 2023).

The digital divide in education encompasses disparities in ICT access, skills, and utilization between teachers and students, shaped by various contextual factors. In China, significant differences in ICT competencies between urban and rural teachers are influenced by their environment and digital literacy levels (Zhao, 2024). In Pakistan, the gap extends beyond physical access to include motivation, skills, and ICT integration in teaching, directly impacting instructional effectiveness (Soomro et al., 2020). Although ICT resources are equitably available in inclusive classrooms in the UAE, insufficient training and resource support remain critical barriers, exacerbating the digital divide (AlSadrani et al., 2020). The COVID-19 pandemic further highlighted the complexities of ICT access, as South African teachers encountered three dimensions of digital disparity in online learning through Virtual Classrooms, WhatsApp, and Radio-Television platforms (Kennedy & Cronje, 2023). These findings underscore the urgency of a holistic, context-driven approach to addressing the digital divide, emphasizing enhanced accessibility, strengthened digital competencies, and optimized ICT integration in pedagogical practices to foster a more inclusive and effective educational ecosystem.

The digital divide between rural and urban areas remains a critical challenge, primarily due to low broadband adoption rates and limited access to advanced ICT services in rural regions (Hollman et al., 2020). This disparity significantly impacts various aspects of life, particularly education, where rural students face greater barriers to accessing online learning materials compared to their urban counterparts (Lembani et al., 2019). The issue is especially pronounced in developing countries such as Indonesia, where inadequate digital infrastructure in rural areas hampers skill development and the effective utilization of digital technology (Hadi, 2018). While ICT adoption has increased, digital technologies have not entirely replaced traditional mobility patterns in either urban or rural settings. Instead, they function as complementary tools, enhancing cost-effective travel planning, particularly with the growing availability of telecommunication services in rural areas (Aderibigbe & Gumbo, 2024). Addressing the digital divide thus requires a holistic approach that acknowledges the interconnectedness of rural and urban regions, including information flows and population mobility, to formulate more comprehensive and effective policies (Hadi, 2018).

Research consistently highlights a persistent digital divide between urban and rural schools, where urban institutions generally benefit from better access to technology and digital resources. This disparity directly affects students' learning experiences and academic achievement. The COVID-19 pandemic further exacerbated these challenges, particularly for rural students, due to limited device availability, inadequate parental support, and ineffective teacher instruction (Yu et al., 2023). Technological inequities extend across different countries. In South Africa, rural students in remote learning settings face significantly greater obstacles than their urban counterparts due to limited access to Information and Communication Technology (ICT) (Lembani et al., 2019). In China, studies indicate that urban elementary school mathematics teachers demonstrate higher proficiency in Technological Pedagogical Content Knowledge (TPACK) and hold more positive attitudes toward technology integration compared to their rural counterparts (Li, 2024). Conversely, research in the United States reveals that urban teachers lag behind their rural and suburban peers in both technology use and perceptions of its effectiveness, with suburban educators exhibiting the highest confidence in technology's instructional benefits (Kormos, 2018). These findings underscore that the digital divide extends beyond mere access to technology; it also encompasses teachers' competencies in leveraging digital tools to enhance learning quality. Addressing this gap requires more inclusive policies that ensure equitable access to technology while simultaneously strengthening educators' capacity for effective technological integration, particularly in underserved regions.

The digital divide in Indonesia remains a critical issue, particularly in education, where disparities between urban and rural areas are pronounced. In Banten Province, cities such as Tangerang, South Tangerang, and Serang benefit from advanced technological infrastructure, high internet penetration, and stronger digital literacy among educators. In contrast, rural areas like Lebak and Pandeglang face persistent challenges, including limited internet access, a shortage of digital devices, and low technical proficiency among teachers. Prior research highlights that urban schools are better equipped for digital transformation than their rural counterparts, which often struggle with digital readiness and accreditation standards (Supardi et al., 2024). This divide is not merely geographical but also reflects socio-economic inequalities, disparities in access to digital resources, and variations in educators' technological competencies and usage patterns (Hadi, 2018). More broadly, the digital gap follows a declining development trajectory from west to east and from urban centers to peripheral regions, although studies indicate a narrowing digital divide between 2015 and 2019 (Kartiasih et al., 2022), significant challenges persist, particularly for educators in coastal and remote areas who continue to struggle with technological adaptation and digital learning constraints (Hamsiah et al., 2024). Addressing this issue requires targeted strategic interventions, including enhanced professional training for teachers and expanded technological infrastructure in underprivileged regions.

The COVID-19 pandemic has accelerated the shift to online learning, with Google Classroom emerging as a primary platform due to its accessibility and ease of use (Nuryatin et al., 2023; Tarteer et al., 2021). Studies highlight its effectiveness in enhancing student comprehension and engagement across various subjects, including Indonesian and English language learning (Nuryatin et al., 2023; Tarteer et al., 2021). However, challenges such as limited internet access and inadequate teacher training continue to hinder its optimal implementation (Tarteer et al., 2021). The successful adoption of online educational technologies by teachers is influenced by key factors, including Information and Communication Technology (ICT) competency, infrastructure availability, and institutional support. Among these, access to digital infrastructure and online resources remains the most critical determinant of effective integration. Despite these limitations, Google Classroom has demonstrated its potential to enhance online learning quality, as evidenced in educational administration practicum courses, where platform-based assignments and quizzes positively impacted student learning outcomes (Kai Wen & Tan, 2020). Google Classroom has emerged as one of the most widely adopted learning platforms, particularly following the shift to online education during the COVID-19 pandemic. Studies indicate that students generally perceive the platform positively and find it beneficial in supporting their learning, especially in writing instruction (Pham & Nguyen, 2024). Its effectiveness has been demonstrated across diverse educational contexts, with significant improvements in student learning outcomes (Kormos, 2018). Additionally, user experience and academic goals play a crucial role in determining its acceptance in higher education settings (Oluyinka & Cusipag, 2021). Students also regard Google Classroom as user-friendly and functional, with substantial potential for enhancing language competencies in goal-oriented learning environments (Basta & Pejić, 2023). These findings collectively affirm Google Classroom's adaptability and efficacy across disciplines and educational levels.

Several studies have highlighted challenges in integrating Google Classroom into the learning process. While the platform has been shown to enhance student achievement in language skills and has received positive feedback for its quick access to materials and efficient feedback mechanisms (Shak et al., 2023; Rosyada & Sundari, 2021), its implementation remains suboptimal due to several constraints. These include limited internet access, interface inconsistencies across devices, and students' preference for private chat communication. Moreover, technology integration in education is not merely a matter of digital adoption but a complex, multidimensional process that often falls short of full utilization (Akcil et al., 2021). Despite these challenges, Google Classroom's user-friendly features such as intuitive navigation, clear instructional design, and task reminders continue to be well-received by students (Rosyada & Sundari, 2021). However, existing research remains limited, focusing primarily on short-term user perceptions without longitudinal approaches that capture the long-term dynamics of its adoption (Shak et al., 2023). Without addressing these challenges, educators in rural areas will continue to face barriers in adopting educational technology, ultimately hindering improvements in teaching and learning quality. This study addresses the research gap concerning disparities in facilitative conditions and the level of Google Classroom utilization among teachers in rural and urban schools. Specifically, it aims to: (1) analyze significant differences in facilitative conditions including network connectivity, technical constraints, and school infrastructure between rural and urban teachers in using Google Classroom; and (2) identify significant differences in the extent of Google Classroom adoption between these two groups.

Hypotheses:

- H1: There is a significant difference in network connectivity between rural and urban teachers in Google Classroom usage.
- H2: There is a significant difference in technical constraints between rural and urban teachers in Google Classroom usage.

H3: There is a significant difference in school infrastructure between rural and urban teachers in Google Classroom usage.

H4: There is a significant difference in the level of Google Classroom utilization between rural and urban teachers.

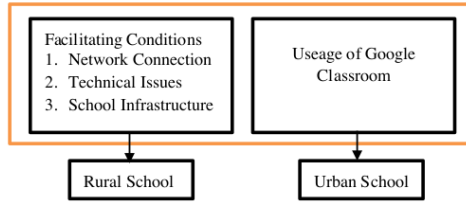


Figure 1. Research Framework

2. METHOD

This study employs a quantitative approach, involving 395 secondary school ICT teachers from urban (Tangerang City, South Tangerang City, and Serang City) and rural (Lebak and Pandeglang) areas, selected through stratified sampling to address two primary research questions. The quantitative method was chosen due to the limited studies specifically exploring Google Classroom usage and assessing disparities in access and utilization between urban and rural schools on a national scale (Yap et al., 2024; Chuah & Mohamad, 2020). Data were collected via an online questionnaire using Google Forms, designed to examine significant differences in supporting conditions, including network connectivity, technical constraints, and school infrastructure, while comparing Google Classroom adoption rates between urban and rural teachers. The research instrument was developed based on a literature review and empirical insights from secondary school teachers and was validated by two experts in educational technology and quantitative methods to ensure content validity. The questionnaire comprised three main sections: (1) four items collecting demographic information, (2) thirteen items assessing supporting factors such as network connectivity, technical barriers, and infrastructure, and (3) five items evaluating Google Classroom usage. Responses were measured using a five-point Likert scale (strongly disagree to strongly agree) for supporting conditions and a seven-point Likert scale (never to always) for Google Classroom usage frequency.

Prior to the main study, a preliminary test was conducted with 31 secondary school teachers to assess the clarity and reliability of the research instrument. To evaluate reliability, Cronbach's Alpha (α) and McDonald's Omega (ω) were employed. Hayes and Coutts (2020) recommend Omega over Alpha, as the latter is sensitive to the number of items in a questionnaire. They argue that a high Alpha value does not necessarily indicate strong inter-item correlations, particularly in lengthy instruments. This concern is further supported by Sidek et al. (2019), who highlight potential biases in Cronbach's Alpha and advocate for McDonald's Omega as a more robust alternative. However, both measures were applied in this study to ensure comprehensive internal consistency assessment. The results (Table 1) indicate that all dimensions exceeded the acceptable threshold (≥ 0.70) for both Cronbach's Alpha and McDonald's Omega. This aligns with Kalkbrenner (2021), who defines an acceptable range of 0.70–0.84 for Cronbach's Alpha and 0.64–0.80 for McDonald's Omega, confirming the strong internal consistency of the instrument. For data analysis, descriptive statistics and independent-sample t-tests were used to examine significant differences between the study variables.

TABLE 1: RELIABILITY STATISTICS OF THE VARIABLES BASED ON GEOGRAPHIC REGION

Variable	Cronbach's Alpha		McDonald's Omega	
	Pilot Test, n = 31	Actual Test, n = 395	Pilot Test, n = 31	Actual Test, n = 395
Network Connection	0.850	Urban: 0.842 Rural: 0.789	0.870	Urban: 0.860 Rural: 0.801
Technical Issues	0.795	Urban: 0.812 Rural: 0.780	0.810	Urban: 0.828 Rural: 0.795
School Infrastructure	0.880	Urban: 0.895 Rural: 0.840	0.900	Urban: 0.910 Rural: 0.855
Google Classroom Usage	0.960	Urban: 0.945 Rural: 0.880	0.970	Urban: 0.955 Rural: 0.892

Reliability analysis results indicate that internet connectivity and school infrastructure exhibit higher reliability in urban areas than in rural regions, as evidenced by higher Cronbach's Alpha and McDonald's Omega values among teachers in Serang, Tangerang, and Tangerang Selatan compared to those in Lebak and Pandeglang. Technical issues were more frequently reported in rural areas, reflected in slightly lower reliability scores than in urban settings. Meanwhile, Google Classroom usage demonstrated high reliability across both regions, though with greater consistency in urban areas. Overall, these findings highlight a stronger technological readiness in urban schools, underscoring the need for improved infrastructure and technical support in remote areas. The regional reliability disparities further emphasize existing gaps in educational technology access and effectiveness, necessitating more equitable infrastructure development and support strategies.

3. RESULT AND DISCUSSION

Demographic Characteristics of Respondents

The demographic data collected included gender, age group, teaching experience, and school location (Table 2). This study surveyed 395 secondary school teachers in Banten Province, Indonesia, covering urban areas (Kota Serang, Kota Tangerang, and Kota Tangerang Selatan) and rural areas (Lebak and Pandeglang). Of the respondents, 105 (26.6%) were male and 290 (73.4%) were female, reflecting the broader trend in Indonesia's teaching profession, where women constitute the majority due to socio-cultural factors. Regarding age distribution, 92 (23.3%) respondents were aged 25–35, 175 (44.3%) were 36–45, 96 (24.3%) were 46–55, and 32 (8.1%) were 56 or older. This indicates that the majority (44.3%) fell within the 36–45 age group, suggesting a predominance of mid-career teachers. In terms of teaching experience, 85 (21.5%) had less than 10 years, 115 (29.1%) had 11–15 years, 87 (22.0%) had 16–20 years, and 108 (27.3%) had over 21 years, demonstrating a relatively balanced distribution of teaching tenure. Geographically, 160 (40.5%) teachers were from rural areas (Lebak and Pandeglang), while 235 (59.5%) were from urban areas, reflecting a higher concentration of teachers in cities. This urban dominance likely correlates with the greater number of schools and better access to educational resources. Overall, the demographic profile highlights that most respondents were female, middle-aged, and experienced teachers, with a higher proportion working in urban schools, aligning with the concentration of educational institutions in Banten's urban centers.

TABLE 2: DEMOGRAPHIC INFORMATION

Measure	Frequency (f)	Percent (%)
Gender		
Male	105	26.6
Female	290	73.4
Age group		
25 – 35	92	23.3
36 – 45	175	44.3
46 – 55	96	24.3
56 and above	32	8.1
Years of teaching experience		
Under 10	85	21.5
11 – 15	115	29.1
16 – 20	87	22.0
21 and above	108	27.3
Area		
Rural (Lebak, Pandeglang)	160	40.5
Urban (Serang, Tangerang, Tangerang Selatan)	235	59.5

To identify the presence of a digital divide among secondary school teachers, an independent t-test was conducted to analyze significant differences in supporting conditions for learning. The analysis encompassed network connectivity, technical constraints, school infrastructure, and Google Classroom utilization in urban and rural schools. This test aimed to evaluate the extent to which these factors influence access to and integration of technology in the learning process, as well as to determine whether significant disparities exist between the two regions.

TABLE 3: DESCRIPTIVE STATISTICS

Variables	Area of School	Mean	Std. Deviation
Network Connection	Rural Area	3.210	0.875
	Urban Area	3.540	0.920
Technical Issues	Rural Area	2.920	0.765
	Urban Area	3.100	0.780
School Infrastructure	Rural Area	4.000	1.020
	Urban Area	4.200	1.150
Usage of Google Classroom	Rural Area	3.420	1.250
	Urban Area	3.900	1.300

Results from Table 3 and Table 4 reveal significant disparities in the digital divide between urban and rural teachers in Banten Province. In terms of network connectivity, urban teachers reported a higher average score ($M = 3.540$, $SD = 0.920$) than rural teachers ($M = 3.210$, $SD = 0.875$), with a significant difference ($t(392) = -2.354$, $p = 0.019$), indicating better access to stable networks in urban areas. Regarding technical challenges, rural teachers ($M = 2.920$, $SD = 0.765$) faced significantly more difficulties than their urban counterparts ($M = 3.100$, $SD = 0.780$), as confirmed by $t(392) = 2.030$, $p = 0.043$, suggesting that urban teachers have better technical support and familiarity with troubleshooting issues. For school infrastructure, although urban schools ($M = 4.200$, $SD = 1.150$) showed slightly better conditions than rural schools ($M = 4.000$, $SD = 1.020$), the difference was not statistically significant ($t(392) = -1.219$, $p = 0.223$), implying comparable infrastructure quality across regions. However, a significant gap was observed in Google Classroom usage, with urban teachers ($M = 3.900$, $SD = 1.300$) utilizing the platform more frequently than rural teachers ($M = 3.420$, $SD = 1.250$), as indicated by $t(392) = 3.762$, $p < 0.001$. This disparity likely stems from differences in network reliability, technical support, and digital proficiency. In conclusion, the findings confirm a significant digital divide between urban and rural teachers, particularly in network connectivity, technical challenges, and Google Classroom utilization, while school infrastructure remains relatively similar. Targeted policy interventions are crucial to enhancing digital access and support for rural teachers, mitigating educational inequities in technology integration.

TABLE 4: INDEPENDENT SAMPLES T-TEST

Variables	Equal Variances	Levene's Test for Equality of Variances		t-test for Equality of Means				Mean Difference $\pm$ Std. Error
		F	Sig.	t	df	Sig. (2-tailed)		
Network Connection	Assumed	0.210	0.647	-2.354	392	0.019*		-0.330 $\pm$ 0.140
	Not Assumed			-2.354	391.678	0.019*		-0.330 $\pm$ 0.140
Technical Issues	Assumed	0.114	0.736	2.030	392	0.043*		0.180 $\pm$ 0.089
	Not Assumed			2.034	391.902	0.043*		0.180 $\pm$ 0.089
School Infrastructure	Assumed	7.317	0.007**	-1.219	392	0.223		-0.200 $\pm$ 0.106
	Not Assumed			-1.236	388.587	0.217		-0.200 $\pm$ 0.105
Usage of Google Classroom	Assumed	0.268	0.605	3.762	392	0.000***		0.480 $\pm$ 0.137
	Not Assumed			3.747	367.453	0.000***		0.480 $\pm$ 0.138

This study confirms the existence of a digital divide between urban and rural teachers in Banten Province regarding Google Classroom utilization, particularly in network connectivity, technical constraints, and usage levels. An independent t-test was conducted to test the hypotheses and determine significant differences between the two regions.

1. Disparities in Network Access for Teachers in Urban and Rural Areas

This study reveals a significant disparity in network access between urban and rural teachers ($p = 0.019$). Urban teachers have better internet access ($M = 3.540$, $SD = 0.920$) than their rural counterparts ($M = 3.210$, $SD = 0.875$). Despite government and service provider initiatives to enhance network infrastructure, rural areas remain underserved. These findings align with previous studies highlighting network limitations as a major barrier for rural teachers in adopting online learning technologies (Chuah & Mohamad, 2020; Junaidi & Hashim, 2021). Beyond access and ICT implementation gaps, this digital divide adversely affects educational outcomes. Research across China, South Africa, Malaysia, and Pakistan confirms that rural students face greater challenges in online

learning accessibility, including poor internet connectivity, limited device availability, and lower digital literacy (Yanlin & Royo, 2024; Lembani et al., 2019; Zamir & Wang, 2023). Consequently, rural students exhibit lower engagement, satisfaction, and academic performance compared to their urban peers (Yanlin & Royo, 2024). Apart from connectivity issues, rural teachers struggle with heavy workloads, restricted resource accessibility, and insufficient technical support. The COVID-19 pandemic exacerbated these challenges, underscoring the urgency of improving remote learning infrastructure (Zamir & Wang, 2023). Addressing the digital divide requires a systematic intervention focusing on enhanced internet connectivity, equitable device distribution, and improved digital literacy for teachers and students in rural areas (Yanlin & Royo, 2024; Lembani et al., 2019).

Research consistently highlights a significant digital divide between urban and rural areas in developing countries. In Indonesia, rural households have nearly half the internet access of their urban counterparts, exacerbating disparities not only in connectivity but also in digital skills and usage patterns (Hadi, 2018). Rural regions face persistent challenges related to service quality, affordability, and ICT infrastructure reliability (Hollman et al., 2020). Similarly, in China's vocational education system, rural students exhibit lower accessibility to online learning, reduced engagement, and poorer academic performance compared to urban students (Yanlin & Royo, 2024). A comparable divide is evident in teacher professional development, where rural educators in Indonesia and the Middle East have limited digital infrastructure and training opportunities compared to their counterparts in Russia (Soekamto et al., 2022). This study confirms a significant gap in ICT access and implementation between urban and rural areas in Indonesia, including Banten Province, supporting the hypothesis (H1) that network connectivity differs substantially between regions. Urban centers such as Tangerang, South Tangerang, and Serang benefit from superior digital infrastructure, including stable internet connectivity, greater device availability, and higher digital literacy levels. In contrast, rural areas like Lebak and Pandeglang continue to struggle with unreliable internet access, limited technological resources, and insufficient training in digital learning tools. Key barriers to ICT adoption in rural Banten include heavier teacher workloads, inadequate infrastructure, inconsistent internet connectivity, and a lack of technical support (Yanlin & Royo, 2024; Lembani et al., 2019). The COVID-19 pandemic further exacerbated these challenges, underscoring the urgent need for targeted interventions in infrastructure development, digital literacy training, and policy support to ensure equitable access and effective technology utilization in rural education (Zamir & Wang, 2023).

2. Technical Constraints

A significant difference was found in the technical constraints faced by teachers in urban and rural areas of Banten Province ($p = 0.043$). Teachers in rural regions, such as Lebak and Pandeglang ($M = 2.920$, $SD = 0.765$), encountered more frequent technical difficulties than their urban counterparts in Kota Tangerang, Tangerang Selatan, and Kota Serang ($M = 3.100$, $SD = 0.780$). These challenges include limited access to hardware due to a lack of computers and laptops in rural schools, lower device compatibility resulting from the use of low-specification gadgets, and difficulties in managing online student tasks due to inadequate training in digital learning technologies. Geographical disparities further exacerbate these challenges. As part of the Greater Jakarta area, Tangerang and Tangerang Selatan benefit from better technological infrastructure, teacher training centers, and technical support, whereas rural regions like Lebak and Pandeglang continue to face limited access to modern educational technologies. Additionally, the more developed telecommunications infrastructure in urban areas allows for faster and more efficient technical assistance, while rural schools often struggle with a shortage of IT specialists, delaying problem resolution and hindering the effective integration of digital tools in education.

These findings align with Li (2025) and Lin et al. (2024), which highlight that teachers in remote areas are more vulnerable to technical constraints due to inadequate technological infrastructure and insufficient technical training. Consequently, hypothesis H2: H0 is accepted, confirming a significant disparity in technical challenges between urban and rural teachers. This underscores the need for equitable technical support, including the provision of compatible devices and intensive training programs to mitigate the digital divide in education. Recent studies further emphasize substantial gaps in digital competence and pedagogical skills between urban and rural teachers. Urban educators consistently demonstrate superior proficiency in Technological Pedagogical Content Knowledge (TPACK) and overall teaching competence compared to their rural counterparts (Kormos, 2018; Lin et al., 2023; Li, 2024; Lavanya et al., 2024). This disparity stems from greater access to resources, professional development opportunities, and technological infrastructure available to urban teachers (Lin et al., 2023; Li, 2024). Moreover, rural educators face greater technical barriers, including device incompatibility and challenges in managing online tasks (Li, 2024). The digital divide is particularly pronounced in primary education, where urban mathematics teachers exhibit more positive attitudes toward technology integration (Li, 2024). Key contributing factors include data literacy, ICT skills, and teacher attitudes, which significantly shape the urban-rural gap (Lin et al., 2023). Addressing these disparities requires targeted interventions, such as increased funding and enhanced professional development programs for rural educators (Lavanya et al., 2024).

3. School Infrastructure

No significant difference was found in school infrastructure between urban ($M = 4.200$, $SD = 1.150$) and rural areas ($M = 4.000$, $SD = 1.020$), with $p = 0.223$, indicating a relatively equitable distribution of educational facilities. Government initiatives, particularly in funding the maintenance and enhancement of computer laboratories, have contributed to this balance. However, regional disparities persist within Banten Province, where urban areas such as Tangerang City, South Tangerang, and Serang City exhibit better access to digital technology, computer labs, and technology-integrated learning facilities compared to rural districts like Lebak and Pandeglang, which still struggle with limited internet connectivity and digital device availability. While various efforts have been made to improve educational access in remote areas, challenges remain. Previous studies suggest that public schools in urban areas generally outperform private and rural schools in digital infrastructure and accreditation outcomes (Derder et al., 2023). However, research in Kedah, Malaysia, found no significant differences in ICT implementation barriers between urban and rural secondary schools (Yanlin & Royo, 2024), suggesting that factors such as teacher training and policy support may play a more critical role in technology adoption. Therefore, Hypothesis H3: H0 is rejected, confirming no significant difference in school infrastructure between urban and rural areas.

Government initiatives to improve school infrastructure in Banten have benefited rural areas, as evidenced by the construction of computer laboratories in schools across Lebak and Pandeglang. However, urban schools remain at an advantage due to faster access to technological innovations and educational resources. This finding underscores the complex relationship between educational infrastructure, geographic location, and learning quality, necessitating region-specific policies to ensure equitable access to educational resources, particularly in supporting digital transformation in rural schools. Recent studies highlight persistent educational infrastructure disparities between urban and rural areas, which significantly impact student outcomes. In North Sumatra, substantial inequalities in school facilities and infrastructure are evident across regions (Harahap et al., 2024). Similarly, in Ecuador, rural areas benefit more from basic infrastructure improvements than large-scale projects (Aderibigbe & Gumbo, 2024). However, a study in Kedah, Malaysia, found no significant differences in ICT implementation barriers between urban and rural secondary schools (Yanlin & Royo, 2024). In Indonesia, urban schools generally outperform suburban counterparts in digital infrastructure and accreditation outcomes, with public schools having better access to digital devices than private institutions (Derder et al., 2023). These findings highlight the intricate interplay between school infrastructure, geographic disparities, and educational outcomes, emphasizing the need for targeted policies to bridge these gaps and ensure equitable access to educational resources across different regions and school types.

4. Google Classroom Utilization Rate

The study reveals a significant difference in Google Classroom utilization between urban teachers in Kota Tangerang, Kota Tangerang Selatan, and Kota Serang ($M = 3.900$, $SD = 1.300$) and rural teachers in Kabupaten Lebak and Kabupaten Pandeglang ($M = 3.420$, $SD = 1.250$), with $p < 0.001$. Despite improvements in rural internet access, urban teachers exhibit higher usage, likely due to socio-cultural and technological readiness factors. Urban centers such as Kota Tangerang and Kota Tangerang Selatan Banten's economic and industrial hubs benefit from more advanced educational facilities, robust digital infrastructure, and greater access to technology training. These factors enable teachers to integrate technology more seamlessly, aligning with higher expectations for digital pedagogy. Furthermore, urban parents and students tend to offer stronger support for digital learning (Haleema et al., 2022), further optimizing Google Classroom adoption. Recent studies highlight the critical role of digital infrastructure in enhancing teaching effectiveness and educational outcomes. Derder et al. (2023) found that access to digital resources, pedagogical skills, and technical support significantly improve instructional efficacy in public schools. Similarly, Supardi et al. (2024) identified a positive correlation between digital infrastructure and school accreditation, with urban and public schools outperforming suburban and private institutions. Dervishi & Vradi (2022) emphasized the necessity of adequate infrastructure and teacher training for effective digital platform implementation in pre-university education. They noted that while ICT integration improves access, efficiency, and educational quality, adoption rates in India remain lower than global trends. These findings underscore the need for targeted policies to bridge the digital divide and enhance educational outcomes across diverse regions.

Research on online learning during the COVID-19 pandemic in Indonesia reveals that WhatsApp was the most widely used platform, particularly in rural and remote areas (Yanlin & Royo, 2024). This preference stems from its ease of use, accessibility, and functionality under limited internet connectivity. While Google Classroom and YouTube were also utilized, their adoption remained lower in areas with inadequate infrastructure (Maru et al., 2021). Rural educators faced significant challenges, including poor internet access, limited electricity, and a lack of student-owned devices (Derder et al., 2023). Despite these constraints, digital platforms enabled remote teaching and communication, though their effectiveness was hindered by technological and infrastructural limitations (Maru et al., 2021; Derder et al., 2023). Urban areas demonstrated higher adoption rates of Google Classroom due to better digital readiness (Yap et al., 2024). Technology acceptance in education is influenced by

performance expectancy, effort expectancy, social influence, and facilitating conditions (Zulherman et al., 2021). In rural areas, resource scarcity and infrastructure deficiencies pose challenges to digital integration; however, teacher attitudes strongly predict the intention to adopt digital tools (Haleema et al., 2022). To enhance online learning experiences, educators should optimize interactive features and engagement tools in platforms like Google Classroom (Basta & Pejić, 2023). These findings underscore the need for targeted strategies to bridge the digital divide between urban and rural educational environments.

4. CONCLUSION

This study highlights the digital divide between urban and rural secondary schools in Banten Province, particularly in the utilization of Google Classroom. Given the critical role of digital technology in 21st-century education, the challenges faced by teachers especially in rural areas such as Lebak and Pandeglang demand urgent attention. The findings reveal that rural teachers experience significantly greater technical barriers compared to their urban counterparts in cities like Tangerang, South Tangerang, and Serang. These challenges include limited access to hardware, system performance issues, and device compatibility constraints, all of which hinder the effectiveness of online learning. Therefore, educational stakeholders must implement targeted technical support and continuous training programs, particularly for teachers in rural areas, to bridge this technological gap.

This study has significant implications for education policy in addressing the digital divide between urban and rural teachers. A key initiative is the enhancement of professional development programs to equip teachers with the necessary skills to integrate educational technology effectively. These programs not only enhance teachers' digital competencies but also ensure their alignment with the evolving demands of Education 4.0, ultimately improving teaching quality and fostering more meaningful learning experiences for students. One promising initiative is Google for Education, which offers resources and training to refine teaching methodologies. Certification programs such as Google for Education Champions further empower educators to become digital innovators, trainers, and mentors. Beyond individual training, fostering community support and institutional collaboration is essential to addressing challenges faced by rural teachers. Policymakers, school leaders, and government stakeholders must adopt community-based strategies to bridge the digital gap, leveraging insights from initiatives such as Teach for Malaysia, which has successfully supported educators in underserved communities. A similar model can be adapted in Indonesia through urban-rural teacher partnerships. For instance, educators in Tangerang, South Tangerang, and Serang could share their ICT expertise with teachers in Lebak and Pandeglang via community-based training or digital platforms. Furthermore, initiatives such as EDUtech Indonesia provide a valuable forum for educators and policymakers to exchange ideas and explore emerging trends in digital education. To effectively bridge the digital divide in Banten Province, strategic resource allocation and region-specific policies are essential. By integrating technology-driven teacher training, sustained technical support, and public-private sector collaboration, policymakers can foster digital equity in education across both urban and rural regions.

While this study provides valuable insights into the digital divide between urban and rural teachers, several limitations should be acknowledged. First, the data were collected exclusively from secondary school teachers in Banten Province, which may limit the generalizability of the findings to other regions in Indonesia. Second, the study relied solely on a quantitative approach, which may not fully capture the socio-cultural factors influencing technology adoption in online learning. Future research could address these gaps by incorporating qualitative methods, such as interviews or focus group discussions, to explore parental and student support, as well as potential resistance to Google Classroom implementation across diverse settings. Additionally, employing a mixed-method approach or a longitudinal study would provide a deeper understanding of the long-term impact of technology integration in urban and rural education. A more comprehensive, policy-driven approach is crucial to bridging the digital divide, particularly among teachers in Tangerang City, South Tangerang City, and Serang compared to those in Lebak and Pandeglang. By ensuring equitable access to quality digital education, this effort can contribute to a more inclusive and technologically empowered learning environment across Indonesia.

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