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Student Digital Divide Due to Geographic Conditions Among Rural Communities

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ABSTRAK
Kemajuan teknologi informasi dan komunikasi pada abad sekarang telah memberikan perubahan yang luar biasa pada berbagai sektor, termasuk pada bidang pendidikan. Integrasi teknologi dalam pendidikan, khususnya di sekolah dasar dan menengah, menjadi isu penting untuk meningkatkan kualitas pembelajaran dan memperkaya pengalaman belajar Peserta Didik. Desa Lifuleo Kabupaten Kupang NTT adalah salah satu wilayah di daerah kepulauan dan berada di pinggiran kota Kupang memiliki tantangan dalam pemakaian digital. Tujuan penelitian ini untuk mengungkapkan apa saja yang menjadi faktor terjadinya ketimpangan digital di Desa Lifuleo Kabupaten Kupang NTT. Penelitian ini adalah jenis penelitian kualitatif dengan metode wawancaraa dan observasi langsung di lapangan. Hasil penelitian ini mengungkapkan bahwa pengaruh kesenjangan digital akibat kondisi geografis yang berbukit di desa Lifuleo Kabupaten Kupang NTT. Keterlambatan mengakses materi daring, rendahnya partisipasi kelas digital, hingga kesenjangan capaian akademik dengan peserta didik di wilayah rural memberi gambaran nyata bagaimana akses pendidikan berbasis teknologi dapat terhambat hanya karena faktor geografis.

Kata Kunci: Kesenjangan Digital, Kondisi Geografis, Masyarakat Rural

ABSTRACT
The development of information and communication technology in the current century has provided extraordinary changes in various sectors, including the field of education. The integration of technology in education, especially in primary and secondary schools, is an important issue to improve the quality of learning and enrich the learning experience of students. Lifuleo Village, Kupang Regency, NTT is one of the areas in the archipelago and is on the outskirts of Kupang city which has challenges in digital usage. The aim of this research is to reveal what factors cause digital inequality in Lifuleo Village, Kupang Regency, NTT. This research is a type of qualitative research using interview methods and direct observation in the field. The results of this research conclude that the influence of the digital divide is due to the hilly geographical conditions in Lifuleo village, Kupang Regency, NTT, lack of information and communication infrastructure in the Lifuleo area, low internet speed which hinders access to learning materials, costs for internet access are very high.

Keywords: Digital Divide; Geographic Conditions; Rural Society

INTRODUCTION

The development of information and communication technology has had a significant impact on various aspects of life, including the education sector. The implementation of technology in education, especially at the elementary and secondary school levels, has become an important issue for improving the quality of learning and enriching students' learning experiences. Digital learning refers to the educational process that utilizes digital technologies such as computers, the internet, software, and applications to support and transform the way students learn. This provides great potential for the development of innovative learning methods.

Digital learning has great potential to transform the educational process, with the goal of improving accessibility, flexibility, and student participation. However, in order to fully harness this potential, continuous efforts are needed to address various challenges and optimize the application of technology in education (Aziz & Zakir, 2022). In general, the term "digital divide" refers to the gap between individuals who have access to computers, digital technologies, and the internet, and those who do not have such access. This divide is often influenced by factors such as economic, educational, or social conditions. Various factors, such as gender, race, ethnicity, age, geographic location, education, income, and others, have contributed to disparities in access to and use of the internet (Mehra et al., 2020).

The digital divide, particularly in terms of access in rural areas, is also a major concern in rural policies in the UK. Rural communities have stated that variations in the availability and speed of broadband within and between rural communities could lead to a divide between connected and unconnected areas. This can have negative effects on businesses in rural areas and hinder social development in various aspects, such as education, political participation, and community capacity building (Roberts et al., 2017). The digital divide is evident in relation to demographic factors such as older age, income, education, age, gender, and ethnicity (van Dijk, 2006). Education is essentially a consciously designed effort to optimize the potential of

learners as human resources by encouraging and facilitating the learning process. Learning becomes a key element that is crucial in every form of education, making it impossible for education to occur without learning activities. As a process, learning plays a vital role in various disciplines related to education.

According to the National Education System Law No. 20 of 2003, education is a conscious and planned effort in which the learning environment and process are designed in such a way that learners can actively develop their potential. The aim is to shape individuals with strong spiritual and religious values, self-control, good character, intelligence, noble morals, and skills that are beneficial for themselves, society, the nation, and the state.

The education system in Indonesia faces several issues that contribute to the low quality of education. This is evident in weaknesses in education management, disparities in infrastructure between regions, limited government support, and inadequate learning evaluation standards (Maulido et al., 2024). In an era of intense competition, improving the quality of education is a crucial step for every nation, as the quality of education reflects the welfare level of its society and is significantly influenced by the education system. Quality education produces competent human resources capable of managing natural resources more optimally and efficiently. With superior human resources, a country's productivity will increase, enhancing its competitiveness while simultaneously improving the welfare of its people.

The advancement of science and technology marks the arrival of a new era for the world: the era of globalization. In this era, every country must be more open to information and modernization from abroad to avoid isolation in the face of free trade competition. The primary factor driving globalization is the rapid progress in information and communication technology, which has made human life easier and more efficient (Nasution, 2016).

The digital divide experienced by rural communities in Indonesia highlights several contributing factors. First, infrastructure. The lack of supporting facilities such as technology and internet access is the primary cause of the digital divide. In Indonesia, low ICT infrastructure development is particularly evident in eastern regions like Maluku, East Nusa Tenggara, Central Sulawesi, Southeast Sulawesi, and Papua. Second, skills. Beyond the availability of computers and internet access, individual capability in using these tools is crucial for optimal utilization. Low levels of computer and internet literacy are found in regions such as Papua, North Maluku, and East Nusa Tenggara. Third, language. Rural communities often struggle to understand online content due to language barriers, making it easier for them to comprehend information presented in Bahasa Indonesia (Ariyanti, 2015).

Remote areas often face limitations in developing educational infrastructure. A limited number of schools, overcrowded classrooms, and inadequate building conditions are common realities. This situation directly impacts the quality and accessibility of education for communities in these regions (Maulido et al., 2024).The issue of educational disparities between urban and rural areas is not only due to unequal infrastructure but also the ownership of ICT devices in each household. The greatest challenges lie in digital participation, internet network quality, and ICT-related policies.

Internet access in Indonesia is heavily concentrated in Java and urban areas, with penetration rates in cities reaching 71-72%, while rural areas lag behind at only around 42-48%. Additionally, access disparities are evident in household ICT device ownership. According to data from Statistics Indonesia (BPS) in 2018, only 20.05% of urban households owned a computer. Skill gaps pose a significant challenge, affecting not only educators but also students. According to the 2019 NRI report, Indonesia ranked 93rd out of 121 countries in content skills, which include the ability to search for and process information, as well as design or create specific products. This issue is closely tied to digital participation levels, the quality of education, and the utilization of ICT devices such as laptops, tablets, and smartphones.

Despite the continuous advancement of computer and internet technology worldwide, many communities remain marginalized due to the digital divide (Gyabak & Godina, 2011). Limited digital infrastructure, especially in remote or underserved areas, poses a significant barrier to achieving digital inclusion. Restricted access to stable internet connections and inadequate network coverage hinder efforts to provide equitable access to technology and training (Haniko et al., 2023)

According to Oktavianoor (2020), ownership of technological devices is not the primary factor contributing to the digital infrastructure gap in rural communities. Instead, the issue lies in the lack of reliable network connectivity or internet access, which drives the digital divide in terms of infrastructure. One reason why network access in Argosari Village remains inadequate is the presence of only one internet service provider, Telkomsel. Additionally, another challenge faced by the residents of Argosari Village is the lack of network access in several hamlets located in mountainous areas, which further contributes to the digital divide in the village's infrastructure. Educators face significant challenges when teaching students who have limited access to educational technology infrastructure (Gyabak & Godina, 2011).

Geographical conditions and challenging transportation become significant obstacles in providing equal access to education in remote areas (Onitsuka,

2018). The considerable distance between residences and educational institutions can affect students' attendance rates and parental involvement in their children's education (Maulido et al., 2024). Although technological advancements offer positive potential, limited digital access remains a reality in remote areas. The lack of telecommunication infrastructure and minimal technological devices hinders the implementation of digital learning methods, thereby creating a substantial digital divide (Maulido et al., 2024). Concentration is particularly challenging to achieve, as various factors influence students' ability to focus. One such factor is the geographical location of the school (Ismah & Wibiastuti, 2015); (Hadiyat, 2014).

Based on these issues, this study focuses on: 1) the digital divide experienced by students in elementary schools in Lifuleo Village, Kupang Regency, East Nusa Tenggara, and 2) an analysis of the extent to which existing policies can support teachers in improving access to education and reducing the digital divide.

METHODS

This study employs a qualitative method with a case study approach. According to Creswell John W. (2010) in (Hadiyat, 2014), the case study approach is used to investigate specific phenomena (cases) within a particular timeframe and context, such as programs, processes, or social groups. This research involves collecting in-depth information through various data collection methods over a specific period. In this study, the phenomena under focus are the digital divide and the influence of geographical factors on schools and students' residences.

Data collection was conducted from August 2024 to October 2024. This case study was carried out in four elementary schools in Lifuleo: SD Negeri Tuadale, SD Inpres Tuadale, SD Negeri Onitua, and SD GMIT Nefo, all located in Kupang Barat District. The selection of these locations was based on the geographical characteristics of Kupang Barat District, which is on the outskirts of Kupang Regency and situated more than 30 km from Kupang City, the provincial capital. The hilly and arid topography often poses classic challenges in the process of digitalizing education for teachers and students in the area.

The key informants of this study are 15 students from the four schools, while the supporting informants include 4 teachers, one principal from SDN Tuadale, and one elementary school supervisor in Kupang Barat District. Interviews with these sources serve as the primary data for this research. Additionally, secondary data were collected from documentation, telephone interview records, and digital divide questionnaires distributed to teachers as supporting data.

The collected data were analyzed inductively to produce a general overview of various specific findings. The analysis process involved three main steps: data reduction, data presentation, and conclusion drawing or verification, performed iteratively to ensure the accuracy and consistency of the results. This approach aims to construct a comprehensive representation that reflects the desired patterns (Miles & Huberman, 1994) in (Hadiyat, 2014). Each piece of data was compared within its group or unit to examine its relevance to the research questions and objectives. Data analysis was conducted using an interactive analysis model, where the consistency of responses among various respondents was tested by comparing their answers. This process aimed to identify patterns that are consistent and relevant to the research focus.

RESULTS

Based on research findings in the field, it was discovered that the digital divide among students in the Lifuleo area, Kupang Regency, East Nusa Tenggara, includes disparities in access, skills, and the use of information technology. This issue becomes increasingly apparent as technology is more widely utilized in education, both for online learning and as a learning aid. Not all students have adequate devices (such as laptops, tablets, or smartphones) to access learning materials. In many areas, especially in rural or remote regions, internet connectivity remains limited or expensive, making it difficult for students to gain access. Students' abilities to use technology also vary; some possess good digital skills, while others still need to learn how to operate devices and use learning applications. Teachers who lack digital literacy or are unfamiliar with educational technology also pose challenges in optimizing the learning process.

The digital divide in the Lifuleo area, Kupang Barat District, has impacted learning outcomes, as students without adequate access to technology tend to fall behind compared to those with full access. The lack of students' knowledge about digital advancements poses a serious challenge in modern education. With rapidly advancing technology, students who lack digital skills are at risk of falling behind in various ways, both academically and non-academically. Not all teachers possess sufficient digital skills either. This lack of ability makes students less accustomed to utilizing technology in learning. Some students only understand the use of technology for entertainment (such as social media or gaming), while skills for learning, research, or programming remain low. Parental support is crucial in children's digital education; however, in many cases, parents also lack sufficient understanding to guide their children in using technology safely and productively.

The Director of Informatics Empowerment at the Ministry of Communication and Information, Mariam F. Barata, stated that by 2015, the number of internet users in Indonesia had reached only 74 million people, or about 29 percent of the total population, with the majority of users located in urban areas. In

Indonesia, there is still a digital divide within society, even though the internet plays an important role as an entry point to improve people's welfare through the dissemination of information and knowledge (Nasution, 2016).

From interviews with students, it was found that the digital divide in their area causes various obstacles in accessing technology for learning needs. Many students in the Lifuleo area reported that internet access is limited, with low internet speeds hindering access to learning materials that require high bandwidth. The high cost of internet access is also a challenge, making it difficult for some parents to provide continuous internet access. Unstable connections, especially during bad weather or when many people are accessing the internet at the same time, pose another issue. Some students also feel that they do not yet have sufficient digital skills to support their learning. They are not accustomed to securing their accounts or understanding the importance of data privacy, making them more vulnerable to digital risks. Students also complained that the school has not provided much guidance or training in basic digital skills.

The conclusion from the student interviews aligns with the Organization for Economic Cooperation and Development (OECD) definition of the digital divide, which is the inequality that occurs between individuals, households, businesses, and geographical regions based on socio-economic differences, particularly related to access to information, information technology (IT), and the use of the internet in various daily activities (OECD, 2001) dalam (Mulyana et al., 2018)

Network constraints for students in the Lifuleo village, Kupang Barat District, Kupang Regency, East Nusa Tenggara, often serve as a major obstacle in accessing digital education. Many remote villages face limited internet connectivity, either due to unstable connections or a complete lack of access. The absence of telecommunications towers or fiber optic cables makes internet access difficult to reach. In some areas where networks are available, signal quality is often weak or unstable, especially for data, causing learning processes to become slow, frequently interrupted, or completely inaccessible. For some families in rural areas, the cost of internet access can be very high compared to their income, making it difficult for students to maintain consistent access, both at home and at school. In addition to internet access, devices such as computers, laptops, or smartphones are not available or are financially out of reach for students, making it hard for them to connect to digital learning resources. Both students and teachers in rural areas also have limited knowledge of how to use digital devices and the internet due to a lack of training or guidance.

The main reason why Lifuleo village in Kupang Regency, East Nusa Tenggara, where the students and school are located, lacks adequate technological infrastructure is the high investment required to build such infrastructure, such as signal towers, fiber optic networks, or stable electricity sources. In rural areas with smaller populations, these costs may be considered disproportionate to the potential benefits for telecommunications companies and internet service providers. Many rural areas are located in mountainous, forested, or remote regions, making infrastructure development more complicated and expensive. The difficult geographic conditions for accessing these locations add technical challenges and higher operational costs.

Local or central governments often have other, more urgent development priorities, such as road improvements, healthcare facilities, or education. Building technological infrastructure may be considered a secondary priority in areas that are still focused on meeting basic needs. The development and maintenance of technology infrastructure require skilled professionals, who are often difficult to find in rural areas. The lack of human resources with expertise in technology further complicates infrastructure development in these regions. Some rural areas may also face regulatory obstacles or bureaucratic processes that slow down the development of technological infrastructure, such as construction permits or unmet requirements from local governments.

The conclusion from interviews with primary school teachers regarding the digital divide experienced by students in Lifuleo village is as follows: "Our school is located in a remote area far from the city of Kupang. The infrastructure here is still limited, and the school only has basic facilities. The students come from various nearby villages, some of which are difficult to reach due to the distance from their homes to the school and the poor road conditions, which become dusty during the dry season. The majority of the students come from low-income families. Their parents generally work as farmers or daily laborers, and most do not have digital devices at home. Internet signal is very difficult to access here. There are only one or two spots at the school where we can catch a signal, but even then, it is unstable. At home, students almost have no internet access, except for a few who use data packages, but the cost is high for them. Only a small number of students have phones at home, and those usually belong to their parents. Therefore, access to digital learning from home is very limited. This gap is very evident in the learning process. Students here are far behind in digital skills compared to those in urban areas. We struggle to teach technology-based material or encourage them to search for information online because access is limited."

The digital divide is evident from the lack of information and communication infrastructure in eastern Indonesia. In addition, information services are relatively weak, with limited educational content and a

prevalence of non-educational broadcasts. The information technology challenges faced by Indonesia differ from those of other countries, primarily due to its geographical condition as an archipelago. As a result, access to information has not yet reached all areas across the islands (Hadiyat, 2014)

Interview with the Principal Regarding the Digital Divide Among Students in Rural Areas The principal highlighted several key factors. In many rural areas, internet signals remain weak or entirely unavailable. This makes it difficult for students to access information and learning materials. The principal stated that uneven telecommunications infrastructure is a major challenge that needs to be addressed. The principal emphasized that in rural areas, digital literacy skills are still low. Teachers and students are not yet accustomed to using educational software, online platforms, or applications that support the learning process. This results in a reliance on face-to-face learning, which is difficult to adapt to digital methods. The principal also shared that teachers in rural areas face challenges in participating in professional development training on digital technology due to limited resources and access. However, these skills are crucial to ensuring that teachers can effectively utilize technology in the learning process.

Interview with a School Supervisor on the Digital Divide in Lifuleo Village Schools, Kupang Regency, East Nusa Tenggara Several important issues emerged regarding the challenges of integrating technology into education. The school supervisor explained that many schools in Lifuleo Village lack supporting facilities such as adequate internet networks, computer labs, or access to modern devices. Many schools still rely on conventional teaching methods due to the absence of digital infrastructure that supports online or hybrid learning. Most teachers in rural areas do not yet possess sufficient skills in using educational technology. The limited availability of training and guidance in the field of technology leads to difficulties in implementing digital learning media. These skills are crucial to ensure that teachers can deliver materials in engaging ways that meet the needs of today's students. The supervisor acknowledged a significant gap in facilities between rural and urban schools. Schools in major cities generally have digital devices, Wi-Fi, and access to advanced digital learning platforms. However, in rural areas, such conditions are rare, making the learning process less effective and unequal. Operational funds are often insufficient to provide digital devices or pay for internet subscriptions. The supervisor noted that without additional financial support from the government or other parties, it is difficult for rural schools to provide the same access as urban schools. Implementing technology-based curricula in rural schools remains challenging. With limited access and resources, rural schools must adapt gradually, which often creates gaps in material comprehension between students in rural and urban areas.

The Difference in Infrastructure Between Rural and Urban Areas Urban areas demonstrate superior access to electricity, telecommunications, and digital capabilities compared to rural regions. Many rural areas remain unconnected, leaving them lagging behind. The lack of access to technology poses a significant barrier to integrating technology in developing regions. Recent studies reveal that global access to hardware in schools has improved significantly. However, more empirical evidence is needed to understand how infrastructure continues to play a critical role in perpetuating the digital divide (Wang, 2013).

Geographical Conditions Worsen the Digital Divide in Rural Schools Geographical factors play a significant role in exacerbating the digital divide in rural schools. Schools in remote areas are often hindered by challenging terrains, such as hills, mountains, or long distances from urban centers. These conditions make it difficult to develop the necessary telecommunications and electricity infrastructure to support educational technology.

Internet access in rural areas is often weak or nonexistent, and when available, it is frequently more expensive. Due to these limitations, students and teachers in rural schools struggle to utilize digital learning platforms, further exacerbating disparities in access to information, technological skills, and educational resources. Consequently, the digital divide becomes more pronounced between rural and urban schools, especially in terms of access to information and the development of digital skills, hindering educational equity.

The geographical conditions of Lifuleo Village in Kupang Regency, East Nusa Tenggara, make it difficult for students to access digital information. Many remote areas are isolated by challenging terrains, such as mountains, forests, and long distances from urban centers, leading to poorly developed telecommunications infrastructure. Limited internet connectivity and unstable electricity in the region worsen the difficulties students face in using digital devices or accessing online learning materials. Additionally, internet access in rural areas is often costly and unreliable, further impeding students' ability to search for digital information necessary to support their studies. These limitations widen the knowledge gap between rural and urban students, where digital information is more accessible and affordable.

The digital divide refers to the disparity in access to information and technology, which creates unequal opportunities among individuals, businesses, and regions with varying socioeconomic levels (Mubah et al., 2017). Geographical location is one of the key factors influencing individual access to ICT. Although ICT offers alternative communication methods for geographically isolated communities, rural residents

continue to lag behind their urban counterparts. This is primarily due to limited telecommunications infrastructure and cultural factors (Hindman, 2000) , as cited in (Hadiyat, 2014).

The interview with the teacher revealed that challenging geographical conditions, especially in rural and remote areas, directly contribute to the digital divide experienced by students. Some key impacts of these geographical limitations on the digital divide include being far from telecommunication networks, resulting in slow, expensive, or even unavailable internet access. Schools located in remote areas are often difficult to reach for the distribution of digital devices, such as computers or tablets, which are typically provided as educational aid. The long distances and difficult terrain slow down access to technology for schools in rural areas.Geographical conditions exacerbate the digital divide between students in rural and urban areas. Students in remote regions need infrastructure support and specialized training to reduce their lag in utilizing digital technology and to promote educational equity.

In an interview with the principal regarding the geographical conditions students face in accessing school and utilizing digital technology, several key challenges were highlighted. Many students have to travel long distances along rocky roads and across hills to reach the school. These conditions often make them late or even unable to attend, especially in bad weather. This situation clearly impacts their learning continuity and makes it difficult for them to follow lessons regularly. At the school, internet access is almost nonexistent due to limited network coverage in the remote area. The principal mentioned that although they wish to implement digital technology in teaching, inadequate internet connectivity is a significant barrier. Students cannot access online learning materials or search for additional information on the internet. The principal also revealed that the absence of digital devices, such as computers or tablets, worsens students' lag in developing technological skills. Rural schools often lack sufficient budgets to purchase these devices, and the distribution of educational aid is limited due to the difficulty of accessing remote areas. There is also a shortage of electricity or unstable power supply. The principal emphasized that without adequate electricity, the available digital devices cannot be optimally utilized. As a result, the school often relies on traditional teaching methods, and digital technology remains underused. Additionally, the limited economic conditions prevent students from purchasing devices or data packages for online learning at home. This leads to a gap in their ability to access digital resources that could actually support their learning.

CONCLUSION

The results of this study reveal the impact of the digital divide due to the hilly geography of Lifuleo Village, Kupang Regency, East Nusa Tenggara (NTT). Delays in accessing online materials, low participation in digital classes, and the disparity in academic achievement compared to students in rural areas provide a clear picture of how access to technology-based education can be hampered simply by geographic factors.

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