Digitalization of Education in the Banten Coastal Region: A Case Study of the Diffusion of Digital Technology Innovation at Bayah Raya High School

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Abstract. Digital transformation is driving social and economic change in various parts of the world, including rural areas. The rural areas often experience a "second-level digital divide" where access to technology does not correlate with digital literacy.This study aims to analyze the diffusion of digital technology innovations—specifically ICT devices (laptops, projectors) and social media platforms—in rural schools, using Bayah Village in Lebak Regency as a case study. This location was chosen due to its extreme poverty levels and high-risk coastal geography, which create unique infrastructure barriers. Using qualitative research and Rogers' Diffution of Innovation Theory, research data was collected through in-depth interviews with three teachers and one high school student. The results show that the process of digital technology adoption in rural schools is still in its early stages. The main factors hindering this adoption process include a lack of information and communication technology (ICT) facilities, human resource support, and adequate digital media literacy. Although some students have an innovator character that utilizes technology for economic and creative purposes, most use technology only for entertainment. Another finding in this study is that the adoption of technology without proper supervision can have negative impacts, such as online gambling among students. This study also highlights the importance of government and private sector support in improving infrastructure, developing curricula, and providing digital literacy education for all stakeholders, not just the provision of devices. This is in order to realize an inclusive and sustainable rural digital transformation.

Keywords: Banten, Diffusion Of Innovation, Digital Communication, Infrastructure, Rural Education

1 Introduction

Digital transformation has become one of the drivers of social and economic change in various parts of the world, including rural areas (Buonocore, 2024). Until now, rural areas have experienced limited access to resources and information. However, digital transformation offers vast opportunities to improve the economic welfare of communities by strengthening human capital and increasing digital literacy (Nouria, 2024). In this case, human capital, which includes individual skills, knowledge, and abilities, is

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a key factor in the successful adoption of digital technology (Brey, 2024). With adequate digital skills and literacy, rural communities can access information more quickly, carry out activities effectively, and take advantage of broader market opportunities.

The condition of rural communities in Indonesia is still marked by various complex socioeconomic constraints. These range from limited access to financial resources, uneven digital infrastructure, and low levels of digital literacy. All of these limitations are major challenges that must be overcome so that rural communities can benefit from advances in digital technology. It is important to understand that when rural communities have adequate digital literacy skills, they are able to reap the benefits for their livelihoods (Ma X et al., 2024). This is also happening in Indonesia, where digital transformation can drive changes in the livelihoods of rural communities, giving them the opportunity to improve their skills and standard of living (Fahmi, 2024). Therefore, digital transformation plays an important role as a bridge in connecting rural communities from socio-economic limitations to better economic opportunities.

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Based on information from the Banten Provincial Statistics Agency in 2024, there is data on the poverty line according to regencies/cities in Banten Province (rupiah/capita/month), in which Lebak Regency is included in the top 3 regencies with a total of 440,705 (BPS Banten, 2024). This shows that economically, Lebak is a region that falls into the category of extreme poverty. Economic, social, and physical aspects are interrelated, which can lead to poverty (Sukanto, 2019). Limitations in these various aspects ultimately lock each other in, creating structural conditions that perpetuate poverty. In this context, digital transformation offers great potential to break this cycle by opening up alternative access to education, health, and economic opportunities. Furthermore, the selection of this research location is critical due to its coastal position, which carries a moderate to high risk of earthquakes and tsunamis. This geographic factor exacerbates the **digital divide**; for instance, when power outages occur—a frequent event in this remote area—the local Base Transceiver Station (BTS) shuts down, leading to a total loss of internet signal.

In the context of education, digital transformation is expected to overcome geographical and social disparities (Fajri et al., 2023). Digital transformation in education is considered a way to improve the quality of teaching and bridge the knowledge gap between urban and rural areas (Lwoga & Ngulube, 2019). However, the process of adopting innovation does not always run smoothly. The digital divide between urban and rural areas is a barrier (Hadi, 2018). Infrastructure challenges, skill gaps, and social resistance in rural areas are significant obstacles that slow down the diffusion of technology (van Dijk, 2020). Inadequate digital infrastructure, such as slow or unstable internet connections and limited access to technological devices, hinders the community's ability to adopt the latest technology. Other factors include cultural and social resistance

to change, where communities accustomed to traditional lifestyles find it difficult or are reluctant to adapt to new technologies.

To achieve successful digital transformation implementation, synergy and cooperation from various parties are needed to increase efficiency and encourage the necessary innovation (Balahurovska, 2023). The sustainability of digital transformation initiatives requires strategies that involve all levels of society and stakeholders to ensure that the technology adopted is in line with local needs. This condition directly impacts access to education and technology adoption, as limited purchasing power affects digital device ownership, while the economic status of the region can limit infrastructure investment (Sahu, 2020).

The technology specifically discussed in this research includes Information and Communication Technology (ICT) devices like laptops and projectors, as well as digital platforms like Instagram, TikTok, and YouTube used for educational content. Despite the introduction of these technologies, a **second-level digital divide** persists—where students have physical access but lack the basic skills, such as typing, to use the technology productively. Therefore, this study aims to answer: "How does the process of digital technology innovation diffusion occur in rural schools facing these specific socio-economic and geographic barriers?"

2 Literature Review

Digital transformation is inseparable from the process of innovation diffusion as part of the dissemination and adoption of new technologies in social systems. Rogers (2010) explains that innovation diffusion is the process of disseminating and adopting a new idea or technology. Communication plays a crucial role in the success of this process. There are four important elements in innovation diffusion, namely the innovation itself, the communication channels used to disseminate information, the time dimension required, and the social system where the innovation is disseminated. In addition, the process of accepting innovation also occurs through various stages, such as awareness, persuasion, decision, implementation, and continuation.

Many studies have discussed the topic of innovation diffusion from various aspects and cases. For example, Wibowo (2019) explains that the role of leaders in an organization has a strong influence on the innovation process. However, the success of innovation is inseparable from the communication strategies that can be implemented, both in terms of the context of group communication channels, opinion leaders, interpersonal communication, and word-of-mouth communication models (Sofyan & Arifin, 2018).

The innovation adoption process is also carried out in the fisheries sector, for example in fish farming in buckets (budikdamber) carried out by the people of Lampung (Astuti et al, 2023). In addition, in the agricultural sector, the innovation diffusion process is used to increase agricultural yields. However, it should be noted that the success of this process is inseparable from the farmer group leaders as self-help leaders who have been trusted by the community so that farmer groups can develop agricultural innovations well (Annafi, 2023).

There are also other studies that discuss the digital divide due to physical accessibility, such as the availability of adequate Information and Communication Technology (ICT) devices and internet connectivity (Lwoga & Ngulube, 2019; van Dijk, 2020). In addition, the issue of digital innovation has also touched on economic transactions, resulting in the widespread use of digital payment applications, thereby expanding the use of financial technology (Alifi, 2023; Hidayat, 2023). Even in the process of religious counseling, information technology has been adopted as an effective counseling medium (Sudarso & Natonis, 2025).

Basically, research on innovation diffusion has been conducted from various aspects. Meanwhile, this study analyzes the process of innovation diffusion in the field of education, particularly at the high school level. However, what is new in this study is related to the selection of samples. This study focuses on schools located in areas with moderate to high risk of earthquakes and tsunamis. In addition, the research was also conducted in schools located in coastal areas with various infrastructure limitations.

3 Research Method

The method used in this study is descriptive qualitative with a case study approach. Yin (2018) argues that the use of case studies aims to understand complex phenomena or situations in depth. The unit of analysis in this study is the diffusion process of digital technology (ICT devices and social media platforms) at Bayah Raya High School, Lebak Regency. The research location was purposively selected to represent a school in a coastal, disaster-prone area with significant infrastructure limitations.

Data was collected through face-to-face in-depth interviews with four participants in July and August 2025 in Lebak Regency, Banten. Participants were selected using purposive sampling to ensure they had direct experience and relevant understanding. They were an elementary school teacher (Ade SuhermanAS), a vocational school teacher (Aldi/A), a high school teacher (Rini/R), and a high school student (Lala/L). After the data was collected, the researcher analyzed it using a thematic analysis method that included: (1) data transcription, (2) coding, (3) theme identification, and (4) interpretation.

4 Results and Discussions

Based on the results of in-depth interviews with the four informants, the researcher categorized the findings based on key elements of the diffusion of innovation theory (Rogers, 2010).

1) Innovation; the use of digital technology in schools includes curriculum, extracurricular activities, and entrepreneurship. For example, teachers instruct students to create content about school activities and upload it to their social media accounts. “When it comes to technology, children are now instructed to create journalism groups, sir. So, every moment is recorded by some children, while others write about the activity. They post it on their Instagram accounts.” (R, interview in August 2025). A small number of students use digital technology for productive purposes and to earn money.

“I have a friend who was able to buy a laptop from playing games, sir.” (L, interview in August 2025). This shows that there are innovators in the school's social system.

2)Communication channels; facilitating the adoption of innovation. Teachers in rural schools use the internet as an additional source of knowledge to support learning. “I have a group of sociology teachers in Banten. There are often learning videos. I sometimes download them from TikTok or YouTube.” (R, interview in August 2025). The process of adopting innovation in schools occurs gradually. For example, the school provides coding training to teachers before incorporating coding into the official curriculum. “As for coding, there are already plans to make it a subject, sir. But the most important thing is that the teachers must master it first.” (R, interview in August 2025).

3) Time; the speed at which people adopt digital technology varies. There are students who are classified as innovators who dare to take risks, such as creating content and selling online. However, there are also teachers and students who are classified as laggards due to their age and lack of digital literacy.

4) Social System; this includes school policies, facilities, and human resources, which play a major role in influencing the diffusion of innovation. Both informants agreed that ICT devices and unstable internet connections in schools were the main obstacles. “There are still not enough devices, sir. For example, we need a lot of projectors, but (teachers) have to take turns using them” (R, interview in August 2025). “The obstacle is the signal. When the lights go out, the BTS automatically goes out too, and the signal is lost. This is a big problem." (AS, interview in July 2025). In addition to access, another problem is the lack of digital skills among students. Informant L stated that some of his school friends still do not know how to use ICT devices, not that they cannot. On the contrary, some of his school friends have experienced negative effects from the use of digital technology. “Some are addicted to online gambling, to the point of taking out online loans, and some even use drugs” (L, interview in August 2025).

Based on the results of the research described above, it was found that the process of innovation diffusion in rural schools did not run smoothly because it was influenced by various factors. This is in line with Van Dijk's (2020) research, which found that technology adoption in rural areas often lags behind urban areas. Unstable internet access, limited ICT devices, and a lack of IT teachers and digital literacy training for teachers are obstacles that slow down the process of innovation adoption. Lwoga and Ngulube (2019) found that the digital divide in rural areas is not only about physical access but also human resource readiness. Human resources play an important role as agents of change in facilitating adoption (Rogers, 2010).

The gap in digital knowledge and skills among students indicates the existence of a second-level digital divide (Hargittai, 2002). This condition refers to someone who has access to technology but cannot use it because they lack the skills. In this case, many students do not have basic skills such as typing on a laptop or computer. This condition shows that existing programs in schools have not been effective in building digital literacy. Ramadhan & Santoso (2021) also emphasize the importance of digital literacy for risk mitigation, such as the impact of exposure to harmful content. The adoption of

technology without digital literacy can actually cause social and psychological problems for students (Lim et al., 2018).

Furthermore, the normalization of "online gambling" behavior among students shows that the role of social systems as channels for the diffusion of innovation is uncontrolled. This is in line with the findings of Chen & Li (2021), who state that the adoption of risky behavior is often influenced by peer pressure. Therefore, in order to create a positive digital ecosystem among students, it is necessary to involve not only teachers and schools, but also parents and the general public.

5 Conclusion

The results of the study show that schools in rural areas are still in the early stages of adopting technology. Although there is high awareness and interest among students, the process of innovation diffusion is not running smoothly and evenly.

The digital divide is a major obstacle, particularly in terms of digital skills and literacy, such as the lack of IT teachers and the availability of ICT devices in schools. In addition, although there are some students who fall into the innovators and early adopters categories by utilizing technology for economic and creative purposes, most students and teachers fall into the early majority and laggards categories. This shows that the adoption of digital technology is still uneven in schools. Furthermore, the adoption of technology without proper supervision can actually have negative impacts, such as online gambling among students.

Overall, the diffusion of digital technology innovation in rural schools cannot be achieved simply by providing devices. Support from the government and the private sector is needed to improve infrastructure, develop curricula, and provide digital literacy education for all stakeholders. This is necessary to realize an inclusive and sustainable digital transformation in schools.

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