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Technology Integration and Internet Connectivity Challenges in the Learning Process: A Literature Analysis

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ABSTRACT

The integration of technology in education has become essential in the digital era, yet its implementation in Indonesia still faces significant challenges. This study aims to analyze technological barriers and their impact on the learning process through library research, reviewing journals, educational reports, and relevant studies. The findings show that technology can enhance flexibility and learning quality, but major obstacles arise from limited infrastructure, insufficient devices, high internet costs, and low digital literacy among teachers and students. The digital divide is especially evident in remote 3T regions with inadequate network access, affecting learning equity and student motivation. Furthermore, the limited readiness of educators and institutional resistance to innovation reduce the effectiveness of digital learning. This study emphasizes that successful digital transformation in education requires comprehensive support, including improved teacher competence, equitable access to infrastructure, and adaptive policies to ensure an inclusive and sustainable implementation.

Introduction

The development of information and communication technology (ICT) in the digital age has brought about major changes to the education system, particularly in the design and management of learning resources (Switri, 2019). The integration of technology is no longer merely an option but a systemic necessity to improve the quality of national education, as mandated by Article 3 of Law No. 20 of 2003. From an Islamic perspective, the utilization of this technology aligns with humanity's responsibility to cultivate the earth, which must be grounded in the principle of justice ('adl) as stated in Surah An-Nahl (16): 90, as well as the moral responsibility to act based on scientific knowledge, as emphasized in Surah Al-Isra' (17): 36.

However, the reality on the ground shows that the integration of educational technology in Indonesia still faces massive structural barriers. Recent studies reveal a digital divide caused not only by physical infrastructure but also by a lack of training, institutional support, and low pedagogical competence among teachers in utilizing technology meaningfully (Yulianto, 2025). This situation widens the gap between urban and rural areas, or the 3T regions (Underdeveloped, Frontier, and Outermost). Barriers to internet connectivity, high data plan costs, and limited access to devices are causing students from low-income families to fall further behind (Muhammad Herman, 2025). On the other hand, online learning also faces pedagogical challenges, such as decreased motivation due to the loss of face-to-face interaction (Fathurrahman et al., 2023) and institutional resistance to adapting to digital culture.

Various learning models—such as synchronous (Zoom/Google Meet), asynchronous (LMS), blended learning, and the flipped classroom—have been widely implemented. However, the effectiveness of these models heavily depends on the stability of connectivity and local technical readiness.

Although previous research has extensively explored the effectiveness of digital learning models in general, most of these studies are still dominated by macro-level data or focus on urban areas with well-established infrastructure. A research gap has emerged due to the scarcity of in-depth reflections that directly capture the reality of digital learning from the perspective of geographically isolated, extremely rural areas. This study aims to fill that gap through a reflective, field-observation-based approach focused on communities with severely limited access. In regions with these characteristics, difficult physical access is intertwined with digital isolation, where interaction with technology is severely limited and relies solely on unstable, voucher-based cellular networks.

The novelty of this article lies in its critical analysis, which confronts modern digital learning models with the sociological realities and actual limitations in these rural areas. Through this approach, the challenges of technology integration are no longer viewed merely as operational technical issues, but rather as a fundamental issue of educational access equity. The results of this study are expected to serve as a conceptual foundation for formulating inclusive learning strategies and more adaptive educational policies for regions not yet reached by digital equity.

Material and Methods

This study uses the *library research* method, which is the collection and analysis of data sourced from literature without conducting field observations. Data was obtained from scientific journals, educational reports, case studies, and articles related to learning technology that are relevant to technological limitations and internet connectivity in the learning process. Data collection was carried out through keyword searches, selection of credible sources, and content recording, which was then analyzed using *content analysis* through a process of categorization, comparison, and synthesis of findings. This method was chosen because it is suitable for producing descriptive-analytical studies based on available academic documentation.

Results and Discussions

A. The Impact of Technological Limitations and Internet Connectivity on the Learning Process

The current development of technology is progressing very rapidly when viewed from the major changes in the world of education. (Yulia, 2024) This is because it allows the learning process to be more flexible through platforms such as *Zoom, Google Meet, Google Classroom, Quizizz,* and other digital media. The use of this technology makes learning more interactive, easily accessible, and not limited by space and time. Figures like Edward L. Thorndike and B.F. Skinner also contributed foundational ideas for educational technology through behavior reinforcement theory, which emphasizes the effectiveness of learning when students' responses are rewarded. This theory is now applied in digital learning design.(Yulia, 2024) Thus, educational technology plays a crucial role in improving the quality of the learning process and has become an integral part of modern learning practices.

However, amid current technological advances, for regions with limited access and generational gaps, technological advances have a significant impact. Digital technology does provide opportunities for teachers and students to access learning materials, interact, and participate in learning without being limited by space and time, but in reality, its use is not

yet evenly distributed. Limited network access in many areas, especially rural areas, causes educational disparities and hinders students from participating in digital learning. (Mesi Manaor Purba, 2025)

Approximately 80% of students in Indonesia have adequate internet access, while many schools in remote areas still rely on traditional technology. This situation is exacerbated by the low level of digital literacy among teachers, who often still manage performance manually even though digital devices are available. (In addition, the success of the policy also depends heavily on technical support and supervision from the government, as many schools still lack guidance in the use of technology for teacher performance management. Therefore, infrastructure equalization and training are needed so that technology adoption can proceed more quickly and improve the efficiency and quality of teacher and principal performance management. (Mochamad Nashrullah, 2025)

Limitations in technology and internet connectivity still affect the smooth running of the learning process because unequal access causes differences in the quality of learning experiences between regions. This shows that the use of technology in education cannot yet be enjoyed equally by all students.

B. Forms of Technological and Connectivity Barriers in Learning

Although technological limitations and internet connectivity have been proven to affect the smoothness of the learning process, these barriers do not appear in a single form. In practice, obstacles that occur in educational environments can originate from various interrelated aspects that affect the ability of students and teachers to participate in technology-based learning. To understand their impact more deeply, these barriers can be classified into several forms that indicate their causes and characteristics in the learning process.

1. *Human Bar*riers

Human barriers to the use of learning technology often arise due to differences in ability, readiness, and levels of digital literacy in educational settings. Teachers who entered the education field before 2000 generally still have difficulty using technology, while 21st-century students are more proficient, creating a skills gap that can seriously affect the learning process. (Hulu, 2023) Teachers are required to have the knowledge and skills to operate devices and digital resources so that teaching and learning activities can take place effectively. (Noviani, 2019) These obstacles are exacerbated by low digital literacy, especially among people with lower levels of education, which further limits the use of network technology in learning. (Mesi Manaor Purba, 2025) In addition to capability, the mentality and integrity of those involved in education also play a role, as weak institutional morals and ethics can hinder the development of the education system, including the use of technology.

(Husnul Khotimah, 2019) It is also not uncommon for teachers to lack confidence in teaching using technology because they are afraid of failing to teach, even though it is highly recommended. (Sawitri, 2019) Thus, the human factor is one of the main obstacles in the application of technology and internet connectivity in the learning environment.

2. Barriers in Terms of Equipment and Infrastructure (*Technical Barriers*)

Barriers in terms of equipment and infrastructure are evident in the uneven availability of technological support facilities, especially in hard-to-reach areas. Facilities and infrastructure in remote schools are still minimal in terms of quantity and quality, so that the available equipment is unable to keep up with the rapid developments in ICT. (Sawitri, 2019) Limitations in the procurement of technological infrastructure occur because many areas are not easily accessible, so that technological facilities cannot be distributed properly. This condition means that educational institutions in rural areas still use second-hand multimedia devices with outdated specifications, while the cost of procuring ICT facilities is still high and is not matched by adequate budgetary support. (Noviani, 2019)

In addition, many Islamic educational institutions, especially those in less developed areas, face more complex technological infrastructure limitations. The lack of stable and fast internet access is a major obstacle, making it difficult to use *e-learning* platforms, educational software, and digital communication. Furthermore, the lack of hardware such as computers, tablets, and projectors further hinders the widespread adoption of technology in schools and madrasas. (Su'ada, 2024) Thus, limitations in networks and hardware facilities are significant factors that hinder the optimal implementation of technology-based learning.

3. Barriers from the Perspective of Systems and General Policies (*Systematic Barriers*)

Systemic and policy barriers arise because the educational institutional environment is not yet ready to support the comprehensive use of technology. Many Islamic educational institutions have a conservative organizational culture and are less open to innovation, resulting in resistance to change and doubts about the benefits of technology in educational activities. Teachers and administrative staff who have long been accustomed to traditional methods are often reluctant to adapt to new digital-based work methods, compounded by the lack of adequate data security systems that raise concerns about privacy and information protection in digital learning. (Su'ada, 2024) In addition to educators who understand technological developments, support from other human resources such as competent *programmers* or system developers is also needed, as well as a mentality and integrity of educational institutions that are free from malpractice, such as budget corruption. (Husnul Khotimah, 2019) This situation indicates that policies, governance, and institutional culture

that do not support digital transformation are significant barriers to the implementation of educational technology in schools and madrasahs.

C. Case Studies Illustrating the Impact of Technological and Internet Barriers in Learning

The following are some obstacles that illustrate the impact of technological and internet barriers in learning in Indonesia.

1. ANBK Senior High School Level in East Nusa Tenggara Hampered by Network Issues

The implementation of ANBK for senior high schools, vocational schools, and Package C in NTB on August 19-22, 2024 generally ran smoothly, but several schools experienced network disruptions, such as SMAN 2 Langgudu, which was forced to conduct exams at the operator's house due to signal problems. (NTB, 2024) This situation certainly disrupted concentration and deprived students of their right to take the assessment properly. Although the ANBK is used as the basis for mapping the quality of education nationally, this network instability has created inequality and shows that there is still a large technological gap in the implementation of educational evaluation in Indonesia.

2. Limited Access to Educational Technology in 3T Areas

The digitization of education has become an important national agenda, but its implementation remains uneven due to infrastructure limitations in remote areas. Data from the Ministry of Education, Culture, Research, and Technology (Kemendikbudristek) in 2023 shows that only about 36% of schools in disadvantaged areas have adequate internet access, while in regions such as Papua, inland Kalimantan, and NTT, many schools have no network access at all. In Asmat Regency, Papua, for example, around 60% of schools experience unstable internet access, preventing students and teachers from participating in online learning or utilizing educational technology. This ultimately widens the education quality gap, despite the implementation of policies such as the Merdeka Curriculum and the School Movement. (Kasnelly, 2025)

3. Internet costs are rising, but performance remains slow

High internet prices are an obstacle to national economic development, as Indonesia has the most expensive internet prices and slowest speeds in Southeast Asia. Data from 2025 shows that the average price of fixed broadband in Indonesia reached US$0.41 per Mbps, which is much more expensive than the Philippines (US$0.14), Malaysia (US$0.09), Vietnam (US$0.04), Singapore (US$0.03), and Thailand (US$0.02). This situation is considered to reduce production cost efficiency amid stagnant purchasing power, although the

telecommunications sector is still considered to have great potential to improve the situation through accelerated technology adoption. This certainly has an impact on the use of educational technology, which is closely linked to internet access. (Bisnis, 2025)

Based on these case studies, technological barriers and limited internet access have been shown to disrupt learning and cause disparities in the quality of education across different regions. Network disruptions, lack of infrastructure, and high access costs indicate that educational technology has not been utilized equally, meaning that digital challenges still have a direct impact on the effectiveness of the learning process in Indonesia.

D. Efforts to Overcome Technological Limitations in the Learning Process

Based on the existing problems, efforts that can be made to overcome technological limitations in the learning process include the following.

1. Efforts to Overcome *Human Barriers*

To overcome obstacles arising from skills, readiness, and technological gaps, it is necessary to improve the capacity of educators through continuous, needs-based digital literacy training. Special training programs for senior teachers or teachers who entered the profession before the digital era need to be implemented to minimize the capability gap with students. In addition, technical assistance in schools, peer mentoring among teachers, and digital learning communities can increase confidence in using learning technology.

Digital literacy education for people with low levels of education is also an important step to ensure that the use of learning technology is not hampered by the family environment. Strengthening the ethics, professionalism, and integrity of educational institutions is also necessary to foster a work culture that supports technological innovation. Thus, capacity building, mentoring, and *mindset* change are key strategies in overcoming human barriers to technology-based learning.

2. Efforts to Overcome Barriers in Terms of Devices and Infrastructure (*Technical Barriers*)

Solutions to device and infrastructure barriers can be achieved through the provision of more equitable access to technology, especially in remote and hard-to-reach areas. The government and educational institutions need to work together to expand the internet network, add access points, and improve connection stability so that digital learning platforms can be used optimally. The procurement of hardware such as computers, projectors, and tablets must be tailored to the needs of schools, including phased assistance schemes, device grants, and the use of shared digital laboratories. In addition, outdated

multimedia devices need to be updated to support modern learning based on applications and digital content. Strengthening the education technology budget, whether through the Regional Budget (APBD), the School Operational Assistance (BOS) program, or collaboration with the private sector, is a crucial step to ensure the availability of adequate digital learning facilities.

3. **Efforts to Overcome Barriers in Terms of Systems and Policies (*Systematic Barriers*)**

To overcome systemic barriers, educational institutions need to reform their governance and policies to support the consistent and targeted use of technology. Organizational culture can be transformed towards a more adaptive work pattern through socialization, leadership support, and the implementation of internal policies that encourage the use of technology in learning and administrative processes. In addition, data security systems must be strengthened to protect the privacy of students and educators in the digital learning ecosystem. The availability of supporting human resources such as IT technicians, *programmers*, and data managers needs to be increased so that educational institutions do not rely solely on the capabilities of teachers. Budget oversight and the prevention of malpractice are also important so that technology funds are allocated according to educational needs. Thus, clear policies, modern governance, and an institutional culture that is open to change are the main foundations for overcoming systemic barriers to the use of educational technology.

Conclusion

The use of educational technology and internet connectivity plays an important role in improving the quality of learning, but its implementation in Indonesia still faces various obstacles stemming from human factors, limitations in devices and infrastructure, and systems and policies that do not yet fully support digital transformation. Various case studies show that network instability, unequal access to devices, high internet costs, and low digital literacy lead to uneven learning quality and widen the education gap, especially in 3T areas. Therefore, comprehensive efforts are needed, such as improving teachers' digital competencies, equalizing technology infrastructure, strengthening policies, and updating education governance so that digital transformation can take place effectively and all students have equal learning opportunities in the digital age.

Conflict of Interest

"*The authors declare no conflict of interest.*"

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