

# Digital Inclusion and Artificial Intelligence: Strategies for Distance Learning Libraries in Bridging the Information Culture Gap in 3T Regions

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## ABSTRACT

Digital transformation in education has accelerated the expansion of access to information; however, it has also exposed persistent inequalities, particularly in Indonesia's underdeveloped, frontier, and outermost (3T) regions. This study examines how digital inclusion and artificial intelligence (AI) can be strategically integrated within distance library services to bridge the gap in information culture. Adopting a qualitative conceptual approach through systematic literature review and thematic analysis, this research develops an *Inclusive AI-Based Distance Library Framework* as a model for addressing multidimensional disparities in access, digital literacy, and information culture.

The findings reveal that digital inequality in 3T regions extends beyond infrastructure limitations to encompass low levels of digital literacy and underdeveloped information culture. While the adoption of distance education (PJJ) offers potential solutions, its effectiveness is constrained by uneven technological readiness. The proposed model highlights four interconnected layers—infrastructure, technology, human mediation, and information culture—supported by a dynamic feedback loop that emphasizes sustainability. Within this framework, libraries function as critical mediators that facilitate access, foster digital and AI literacy, and contextualize technology use according to local needs.

This study argues that digital inclusion should not be reduced to technological provision alone but must be understood as a socio-cultural transformation process. The integration of AI in library services, when implemented through inclusive and adaptive strategies, can enhance learning equity rather than exacerbate disparities. The model offers both theoretical contributions by integrating digital inclusion, AI, and information culture, and practical implications for policymakers, educational institutions, and library practitioners in developing inclusive digital ecosystems in marginalized regions.

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## I. INTRODUCTION

Digital transformation in the education sector has brought about significant changes in how people access, produce, and utilize information. However, amid this rapid pace of change, the digital divide remains a critical issue, particularly in Indonesia's underdeveloped, frontier, and outermost regions (3T). This gap is not only related to limited access to technology but also reflects disparities in digital literacy and information culture among the population (van Dijk, 2020; UNESCO, 2023)

Nationally, the development of digital access shows a positive trend. The latest data from the Indonesian Internet Service Providers Association indicates that Indonesia's internet penetration rate has reached approximately 80.5% by 2025, with the number of users exceeding 229 million. However, this increase does not yet fully reflect equitable access. Disparities remain evident between urban and rural areas, as well as between developed regions and 3T regions, indicating that the issue of digital inclusion is not only related to the availability of technology but also to its distribution (World Bank, 2022; APJII, 2025)

Structurally, the digital divide in 3T regions can be viewed from three main dimensions. First, limited internet access and technological infrastructure remain fundamental barriers. Data from the Central Statistics Agency shows that although household internet access in rural areas has increased to around 80%, this figure still lags behind that of urban areas, which has reached over 90%. This disparity indicates a significant structural gap in the distribution of digital infrastructure in Indonesia.

Second, the public's low level of digital literacy further widens the inequality gap. Although internet access has increased, the public's ability to use technology critically and productively remains limited. This is reflected in various studies showing that internet use in Indonesia is still dominated by entertainment and communication activities, rather than its use for education and self-improvement (BPS, 2022; UNESCO, 2021). In a global context, results from the Programme for International

Student Assessment (PISA) indicate that Indonesian students' reading literacy skills remain below the OECD average, signaling a serious challenge in fostering a strong culture of literacy (OECD, 2023).

Third, the gap is also evident in the realm of information culture – that is, how people perceive, use, and manage information in their daily lives. An underdeveloped information culture leads to low utilization of digital resources even when access is available (Oliver, 2017; Choo, 2013). In this context, the digital divide evolves into a more complex and multidimensional information culture gap.

In the context of education, the emergence of distance learning has become a strategic solution for reaching geographically remote areas. DL enables the dissemination of knowledge without spatial boundaries; however, its success is highly dependent on the readiness of digital infrastructure, user literacy, and adequate support from the learning ecosystem (Moore & Kearsley, 2012; Hodges et al., 2020). Without such readiness, the implementation of DL risks exacerbating educational access disparities between developed regions and 3T regions.

This is where libraries play a strategic role as part of the digital learning ecosystem. Libraries are no longer merely repositories for collections; instead, they have transformed into hubs for information access, facilitators of digital literacy, and mediators of knowledge within distance learning environments (IFLA, 2022; Lankes, 2016). In the context of 3T regions, libraries have the potential to become knowledge hubs that bridge access gaps while fostering an inclusive and sustainable information culture.

Furthermore, advancements in artificial intelligence (AI) open up new opportunities in the management and dissemination of information. This technology enables the personalization of services, the automation of information curation, and improved efficiency in accessing knowledge (Cox et al., 2019; Luo et al., 2022). However, without being balanced by digital literacy and critical understanding, the use of AI also has the potential to deepen existing information gaps (Selwyn, 2019; UNESCO, 2021).

Given this context, a strategic approach is needed that can integrate digital inclusion, the use of AI technology, and the strengthening of the role of libraries in supporting distance learning, particularly in 3T regions. Therefore, this article seeks to examine

and formulate strategies for distance learning libraries to bridge the information literacy gap through an AI-based digital inclusion approach.

Given this background, the digital divide in 3T regions exhibits multidimensional characteristics encompassing aspects of access, literacy, and information culture. The transformation of distance education and the adoption of artificial intelligence technologies require an approach that is not only technology-based but also oriented toward inclusion and community empowerment (UNESCO, 2023; World Bank, 2022). Therefore, this study is formulated into the following research questions:

1. What are the characteristics of the digital divide in 3T regions in terms of internet access, digital literacy, and information culture?
2. What are the challenges and opportunities for implementing distance education (DE) in the context of this digital divide?
3. What is the strategic role of libraries in supporting an inclusive digital learning ecosystem in 3T regions?
4. How can the use of artificial intelligence (AI) be integrated into distance learning library services without widening the information culture gap?
5. What kind of strategic models can be developed to bridge the information culture gap through libraries based on digital inclusion and AI?

In line with the research questions, this study aims to:

1. Analyze the characteristics of the digital divide in 3T regions, covering aspects of infrastructure, digital literacy, and information culture.
2. Identify challenges and opportunities in the implementation of distance learning (DL) in regions with limited digital access.
3. Examine the strategic role of libraries in supporting digital inclusion and technology-based learning (IFLA, 2022).
4. Explore the potential and risks of utilizing artificial intelligence (AI) in library services, particularly in the context of 3T regions (Cox et al., 2019).
5. Formulating a conceptual strategic model for distance learning libraries based on digital inclusion and AI to bridge the information literacy gap.

## II. LITERATURE REVIEW

### 1. *The Concept of Digital Inclusion in Distance Learning Libraries (DLLs)*

Digital inclusion is not merely about providing access to hardware; rather, it encompasses the meaningful use of technology. According to Warschauer (2003), digital inclusion involves four types of resources: physical, digital, human, and social. In the context of distance learning, libraries serve as a bridge to ensure that students in areas with limited infrastructure not only gain access to digital resources but also have the ability to use them for academic success.

### 2. *Information Literacy Challenges in 3T Regions*

Frontier, Outermost, and Underdeveloped (3T) regions are characterized by geographical and technical barriers. Information literacy in these regions is often hindered by a second-level digital divide—that is, a gap in internet usage skills even when basic access is available. Information culture in 3T regions tends to be pragmatic; therefore, distance learning libraries need to transform students' information-seeking behavior from merely "finding" to critically "evaluating."

### 3. *The Role of Artificial Intelligence (AI) in Information Literacy*

Artificial Intelligence, particularly Generative AI, has transformed the landscape of information retrieval. Lodge et al. (2023) emphasize that AI can serve as a powerful cognitive aid but carries the risk of introducing bias. For distance learning students in 3T regions, AI offers significant opportunities in the form of personal learning assistants capable of operating with low bandwidth (text-based), yet demands new standards in Algorithmic Literacy to prevent students from being misled by inaccurate information (AI hallucinations).

### 4. *Library Strategies to Bridge the Gap*

Previous research on Embedded Librarianship indicates that librarians must be present in the digital spaces where students are active. In the AI era, the librarian's role transforms into that of a facilitator of collaborative intelligence. This strategy involves developing reference platforms tailored for remote areas and curating AI-

generated content whose validity has been verified by human librarians to maintain academic integrity.

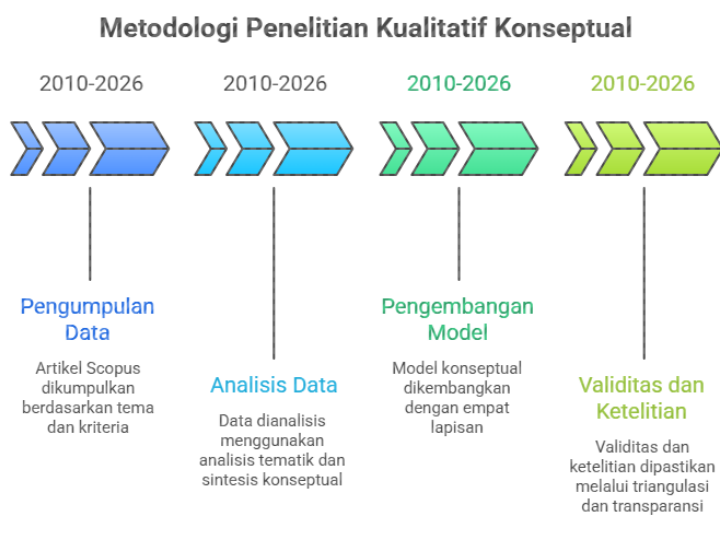
## METHODS

This study employs a conceptual qualitative approach aimed at developing a theoretical model regarding the role of distance learning (DL)-based libraries in bridging the information-culture gap in 3T regions through the integration of digital inclusion and artificial intelligence (AI). This approach was chosen because the study focuses on conceptual synthesis rather than empirical testing, thereby allowing for the comprehensive integration of various theoretical perspectives.

Data sources were obtained through a systematic literature review covering reputable scientific publications (Scopus and Web of Science), reports from international organizations, and national policy documents. The literature used is limited to the period 2010–2025 to ensure relevance and currency. Selection criteria include studies related to digital inclusion, the digital divide, artificial intelligence in education and libraries, information culture, as well as digital library services and distance learning. The data collection process was conducted in four main stages: (1) identification, involving the selection of search keywords such as digital inclusion, AI in libraries, and information culture; (2) screening based on titles and abstracts; (3) eligibility assessment through full-text review; and (4) inclusion of literature that met conceptual and academic quality criteria. This approach follows the principles of a systematic review to ensure transparency and replicability.

Data analysis was conducted using thematic analysis combined with conceptual synthesis. The initial stage involved open coding to identify key concepts from the literature, followed by axial coding to group concepts into thematic categories, and concluded with selective coding to integrate these categories into a coherent conceptual framework. The results of this analysis produced the Inclusive AI-Based Distance Library Framework model, consisting of four main layers: infrastructure, technology, people, and information culture, and equipped with a feedback loop mechanism.

To ensure validity and accuracy, this study applied source triangulation (various types of literature), theoretical triangulation (integration of various theoretical perspectives), and transparency in the data selection and analysis process. Nevertheless, as a conceptual study, this research has limitations in that no empirical testing of the resulting model has been conducted. Therefore, further research is recommended to test this model through a quantitative approach or case studies in 3T regions.



### III. RESULTS

#### 1. Overview of the Conceptual Model

This study produced a conceptual model called the Inclusive AI-Based Distance Library Framework for 3T Regions. This model is designed to explain how distance learning (DL)-based libraries can play a strategic role in bridging the information-culture gap in underdeveloped, frontier, and outermost (3T) regions through the integration of digital inclusion and the utilization of artificial intelligence (AI).

Unlike conventional approaches that position technology as the primary solution, this model adopts a systemic and layered approach, emphasizing the interaction between infrastructure, technology, people, and information culture. This model is also dynamic, characterized by a feedback loop that demonstrates that the digital inclusion process is a continuous cycle, not a one-way intervention.

#### 2. Infrastructure as the Enabling Layer

The first layer in this model is the infrastructure layer, which serves as the primary foundation of the digital inclusion ecosystem. Infrastructure encompasses internet access, device availability, and adequate energy support. In the context of 3T regions, infrastructure limitations remain a major barrier determining communities' access to digital technology.

This finding aligns with Jan van Dijk's perspective through the Digital Divide Theory, which emphasizes that the digital divide stems from inequalities in access to technology. Without an adequate infrastructure foundation, advanced technology-

based interventions such as AI will not yield significant impact. Therefore, this model positions infrastructure as an enabling factor that facilitates the functioning of subsequent layers.

However, this model also acknowledges that within the context of limitations, alternative approaches such as offline digital libraries and low-bandwidth systems serve as relevant adaptive strategies. This demonstrates that digital inclusion is not always synonymous with high connectivity, but rather the ability to provide access tailored to the local context.

### **3. Technology Layer and AI Adoption**

The second layer is the technology layer, which encompasses the use of digital library systems, artificial intelligence, and various other supporting technologies. In this model, technology is not viewed as an end in itself, but rather as a tool for expanding access and improving the quality of information services.

The integration of AI in distance learning libraries opens opportunities for service personalization, such as user-need-based recommendation systems and information service chatbots. However, the adoption of this technology is highly dependent on the level of user acceptance, as explained in the Technology Acceptance Model developed by Fred Davis. This model emphasizes that perceptions of ease of use and the benefits of technology are key factors in determining adoption.

In the context of 3T regions, the main challenge lies not only in the availability of technology but also in the alignment of technology with user needs. Therefore, this model underscores the importance of an “appropriate technology” approach – technology that is simple, adaptive, and relevant to local conditions. Thus, the use of AI in libraries need not rely on complex systems but can begin with simple solutions that yield tangible results.

### **4. Human Layer: Librarians as Mediators**

The third layer is the human layer, which positions librarians as key actors in this ecosystem. In this model, librarians no longer serve as custodians of the collection, but as information mediators and AI facilitators who bridge the interaction between users and technology.

This role can be understood through the perspective of human mediation, which emphasizes that technology cannot stand alone without human intervention capable of interpreting, guiding, and facilitating users. In this context, librarians function as literacy agents who help users understand information while building trust in technology.

Furthermore, in the context of AI, librarians also play a crucial role in ensuring that technology is used ethically and inclusively. Without human mediation, technology has the potential to create bias or even exacerbate existing disparities. Therefore, this model underscores that the success of digital transformation heavily depends on human resource capacity, particularly that of librarians.

### **5. Information Culture as the Transformative Outcome**

The fourth layer is the information culture layer, which is the primary objective of the entire process in this model. Information culture reflects how individuals and communities access, understand, and utilize information in their daily lives.

This concept aligns with the thinking of Chun Wei Choo, who emphasizes that organizations or societies with a strong information culture will be more effective in managing knowledge and making decisions. In the context of the 3T regions, strengthening information culture is a strategic step to ensure that access to technology truly yields sustainable social impact.

This model demonstrates that digital literacy and information literacy cannot be built instantly, but through a gradual process involving the interaction between technology and people. Thus, the success of digital inclusion is measured not by the number of internet users, but by the community's ability to utilize information critically and productively.

### **6. Feedback Loop and Sustainability**

One of the key contributions of this model is the presence of a feedback loop that connects the system's output to its input. The resulting information culture will in turn influence how the community uses technology, which ultimately reinforces the need for better library infrastructure and services.

This approach demonstrates that digital inclusion is an adaptive and sustainable process. In other words, interventions should not be purely top-down but

must involve the active participation of the public as both users and co-creators within the information ecosystem.

## 7. Implications of the Model

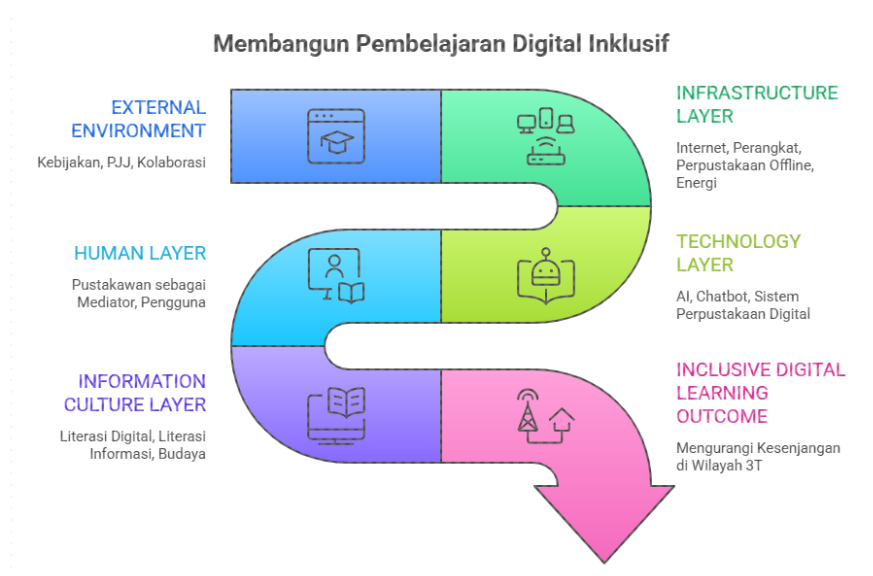
Theoretically, this model contributes by integrating three key domains – digital inclusion, artificial intelligence, and information literacy – within the context of distance learning libraries, an area that has rarely been comprehensively studied. This model also expands the concept of the digital divide into the more complex concept of the information literacy divide.

Practically, this model can serve as a reference for:

- library administrators in designing inclusive AI-based services
- educational institutions in developing community-based distance learning

## 8. Synthesis

Overall, this model underscores that the success of distance learning libraries in bridging the digital divide in 3T regions does not lie solely in technological sophistication, but in the ability to integrate technology with the social and cultural context of the community. Through an inclusive and multi-layered approach, libraries can transform into agents of change that not only provide access to information but also build community capacity to navigate the AI-driven digital era.



This model demonstrates that the success of distance learning libraries in bridging the information gap in 3T regions cannot rely solely on the provision of technology. Rather, a multi-layered approach is required, starting with infrastructure, followed by adaptive technology, and mediated by the active role of librarians as literacy facilitators. This process will ultimately foster a more inclusive information culture, which in turn strengthens the sustainable effectiveness of technology utilization.

Thus, this model emphasizes that digital inclusion is not merely a result of access, but rather a dynamic interaction between technology, people, and information culture.

#### IV. CONCLUSION AND SUGGESTION

This study confirms that the digital divide in 3T regions can no longer be understood solely as an issue of limited access to technology, but rather as a multidimensional phenomenon that encompasses digital literacy and information culture. In this context, the massive digital transformation currently underway has the potential to deepen these inequalities if it is not accompanied by an inclusive and contextual approach.

Through the development of the Inclusive AI-Based Distance Library Framework model, this study demonstrates that distance learning (DL)-based libraries hold a strategic position as mediators in bridging this gap. Libraries function not only as providers of information access but also as facilitators of literacy, connectors between technology and users, and agents in shaping information culture. The integration of artificial intelligence into library services offers significant opportunities to enhance service efficiency and personalization; however, it simultaneously poses the risk of creating new forms of exclusion if not managed wisely.

The key findings of this model confirm that the success of digital inclusion is not determined solely by the level of technology adoption, but rather by the system's ability to integrate four key elements: adequate infrastructure, adaptive technology,

the active role of librarians as mediators, and the strengthening of the community's information culture. Thus, digital inclusion must be understood as an ongoing process of social transformation, not merely a project to provide technology.

Furthermore, this model also emphasizes the importance of a cyclical approach through a feedback loop, in which improvements in information culture will strengthen the utilization of technology, which ultimately drives the need for a more inclusive system. This indicates that interventions in this field must be designed for the long term and oriented toward community empowerment.

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