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Abstract

This study examines the planning, implementation, and service-quality implications of digital literacy strategies in North Sumatra's public service delivery. Data were gathered from planning documents, including the Strategic Plan (Renstra), Work Plan (Renja), and the Government Agency Performance Accountability Report (LAKIP) of the Communication and Informatics Agency (Diskominfo), using a qualitative case study methodology. In-depth interviews were also conducted with key officials. The thematic analysis indicates a clear gap between policy planning, program implementation, and service outcomes. Although digital literacy has been incorporated into regional planning documents, its implementation is constrained by limited technical capacity among civil servants and the public, uneven program coverage, and the absence of legally binding cross-sectoral regulations. As a result, digital public service applications have not yet fully improved public engagement, service efficiency, and information transparency, particularly among vulnerable groups and rural communities. This study does not go into great detail about the role of national initiatives and private sector partners because it is restricted to provincial policy. However, in order to guarantee that digital literacy actually becomes a cornerstone of bureaucratic reform and inclusive public service delivery, the findings provide unique value in the form of a thorough understanding of the necessity of regional regulations, a critical competency-based literacy curriculum, behavior change based evaluation, and a multi-stakeholder collaborative ecosystem.

Keywords: Digital Literacy; Digital transformation; North Sumatra; Public Services; Regional Policy

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INTRODUCTION

Digitalization is now regarded as a necessary component of creating a public administration system that is responsive, effective, and participative [1]. In response to this dynamic, the Indonesian government has reinforced its Electronic-Based Government System (SPBE) strategy, which promotes the digitalization of public services across the board [2]. By this policy, public services must be supported by the digital literacy and abilities of both service providers and recipients, in addition to being application-based. Therefore, human capabilities to operate, comprehend, and make the best use of the system must accompany bureaucratic digitization for it to have any real meaning [3]. Thus, bureaucratic digitalization cannot be understood merely as the development of technological systems and infrastructure, but also as a matter of equitable access, particularly for women, rural communities, and vulnerable groups who may face barriers in utilizing digital public services.

Digital literacy is an important issue in this context and requires immediate attention. Digital literacy does not only refer to the ability to use digital devices, but also includes community education processes that enable people to understand, access, and utilize digital services critically and responsibly [4], [5]. In public services, digital literacy is also closely related to awareness of data security, privacy protection, and the application of digital ethics in online interactions [6]. In addition, digital literacy has an empowerment dimension, particularly for women, rural communities, and vulnerable groups, enabling them not only to become passive users of technology but also to participate actively in digital public services [7]. Xu and Dai (2024) [8] further emphasized that public digital literacy, rather than merely the sophistication of infrastructure, is a critical factor in the success of public sector digitalization [9]. Without equitable digital literacy, digital service systems risk widening access gaps and creating digitally disadvantaged communities [10].

One of the areas speeding up the digital transformation of governmental services is North Sumatra Province. The 2024–2026 Strategic Plan (Renstra), the 2025 Work Plan (Renja), and the performance report in the 2024 LAKIP all contain a number of strategic policies that the local government has produced through the Communication and Informatics Agency (Diskominfo). According to these documents, the goal of regional digital development is to expand ICT infrastructure, enhance public information transparency, and improve SPBE to facilitate the establishment of a 'North Sumatra Smart Province.' Although several strategic indicators have been achieved, low levels of digital literacy among specific target groups, such as women, educators, civil servants, rural communities, farmers, and socially vulnerable groups, remain a major challenge to the effectiveness of digital public services [11], [12], [13].

Previous studies on digital literacy have largely concentrated on education and college students [14], [15], [16], [17]. However, a significant research gap remains concerning the relationship between digital literacy, the quality of public services, and regional policies, particularly in provinces outside Java, such as North Sumatra. This gap is important because, although Indonesia's SPBE policy mandates digital transformation across all levels of government, implementation at the regional level, especially in areas with geographical and socioeconomic diversity, remains underdocumented in academic literature. This study addresses this gap by offering theoretical and practical contributions to the development of digital literacy policies that are more inclusive, contextual, and oriented toward community

welfare. Thus, the findings of this study are expected to serve as a foundation for policymakers, regional bureaucrats, and scholars in designing a systematic digital literacy roadmap, not only to improve the effectiveness of digital public services but also to expand access, reduce digital inequality, and support the welfare of diverse community groups at the regional level.

The following key performance indicators are closely linked to the delivery of digital public services and offer a more tangible view of the region's strategic accomplishments.

Table 1. North Sumatra Communications and Information Service Strategic Indicators Associated with Digital Public Services.

No	Strategic Goals & Indicators	2024	Target (2025–2026)
1	Improving SPBE – SPBE Index	4.0	4.2 → 4.5
2	Transparency – Disclosure Index	85%	4.2 → 4.5
3	Info Management – Management Index	75%	76% → 77%
4	ICT Utilization – App/Network	>95%	>95% → >95%

Source: Processed from the North Sumatra Communications and Information Service's Strategic Plan, Work Plan, and LAKIP

As shown in the table above, North Sumatra has made significant progress in governance, infrastructure, and digital systems. However, the mismatch between the availability of digital systems and people's ability to use them presents a greater challenge [3]. This gap in digital competence can worsen inequalities in access to public services, particularly for rural communities, farmers, low-income groups, women, older adults, and other vulnerable groups. In several rural areas of North Sumatra, internet connectivity disruptions still frequently occur. Although the agricultural sector is the main source of income for rural communities, data show that only 41% of farmers have adequate internet connectivity. In addition, digital literacy training for schools and civil servants remains inconsistent and unsustainable. Access to public service applications, which are often insufficiently supportive and not user-friendly, can also create confusion among the public. The following map of digital literacy issues, which is directly related to the quality of digital public services in North Sumatra, helps illustrate the scope of the challenges encountered.

Table 2. Problems with Digital Literacy and How They Affect Public Services

No	Dimensions of the Problem	Conditions in North Sumatra	Impact on Digital Public Services
1	Access and Connectivity	Just 41% of farmers have internet access, and many villages remain blank spots.	Digital public services are not available in areas without access.
2	Capacity of ASN and Educators	Limited digital training; educators and civil servants do not yet have a broad understanding of SPBE.	Resistance to new systems is still high, and digital services are not at their best.
3	Literacy in the Community	Lack of knowledge about media ethics, personal data, and service applications.	There is little public involvement because digital

No	Dimensions of the Problem	Conditions in North Sumatra	Impact on Digital Public Services
			services are seen as irrelevant or complex.
4	Application Design and Content	Many apps are difficult to use, and there aren't enough instructions in local languages.	Information accessibility issues and a low uptake of public applications.
5	Collaboration and Public Education	There is currently no cross-district/city education model; literacy initiatives are sectoral and irregular.	There isn't a strong and robust digital literacy ecosystem.

This table demonstrates that North Sumatra's digital literacy issues are not just technical; they also have to do with social, policy, and service design issues. Due to the lack of mainstreaming of digital literacy as a strategic component of the public policy cycle, many government initiatives are unsustainable and sectoral [18]. The absence of an integrated digital education model that incorporates collaboration between the government, educational institutions, digital communities, and civil society makes this worse [19].

Fundamental questions are brought up by this circumstance: how has the North Sumatra Provincial Government developed and carried out its digital literacy policy about public services? Can this approach meet the demands of the modern digital age and reach all societal levels? If not, what strategy ought to be created to make digital literacy the cornerstone of inclusive, equitable, and sustainable public services rather than just policy speak? This study seeks to answer these questions through a systematic qualitative inquiry into North Sumatra's Diskominfo planning documents and field interviews.

METHODS

Research Design

This study employed a qualitative descriptive methodology to provide a comprehensive and contextual understanding of public service digital literacy improvement strategies in North Sumatra Province [20]. The qualitative approach was chosen because the research focuses on understanding policy dynamics, implementation processes, and the social context surrounding digital literacy initiatives dimensions that cannot be adequately captured through quantitative measurement alone. This approach aligns with the interpretivist paradigm, which prioritizes depth of understanding over breadth of statistical generalization.

Participants and Sampling

The study site is the North Sumatra Provincial Communication and Informatics Office (Diskominfo), the principal administrator of the Electronic-Based Government System (SPBE) and the organization responsible for executing the digital literacy initiative. The study focuses on developing plans, implementing programs in the field, and identifying possibilities and difficulties for enhancing digital literacy among the public and civil workers.

Primary data were collected through in-depth interviews with eight purposively selected key informants, including structural authorities, technical implementers of SPBE and digital literacy programs, and community representatives such as teachers, students, and digital farmers [21], [22]. Purposive sampling was used to ensure that informants had direct experience with the planning or implementation of digital literacy programs. Secondary data were gathered through document analysis of the 2024–2026 Diskominfo Strategic Plan (Renstra), the 2025 Work Plan (Renja), and the 2024 LAKIP. Non-participatory observation was also conducted on Diskominfo's official digital media platforms and online service applications to evaluate their usability and public accessibility

Operational Definitions of Variables

For the purpose of this study, “digital literacy improvement” is defined as the enhancement of the public’s and civil workers' ability to access, evaluate, and utilize digital tools effectively within the context of public service delivery. This includes both foundational digital skills (e.g., use of computers and the internet) and advanced competencies such as information security, digital communication, and civic engagement through digital platforms.

Hypotheses Development

Given the qualitative nature of the research, this study did not rely on formal hypotheses but rather explored the factors influencing the successful implementation of digital literacy programs. The study aims to understand the barriers and opportunities that exist in the development and execution of digital literacy programs within the region.

Data Collection Procedure

Data collection was carried out using three primary methods:

1. In-depth interviews: Eight purposively selected key informants were interviewed, including individuals with direct experience in the digital literacy programs at Diskominfo and related stakeholders.
2. Document analysis: Secondary data were gathered from official documents, including the 2024–2026 Strategic Plan (Renstra) and the 2025 Work Plan (Renja).
3. Non-participatory observation: Observations were made of the usability and accessibility of digital services provided by Diskominfo on their official digital platforms.

Data Analysis

Data analysis employed a thematic approach, involving coding of interview transcripts and classification into themes such as public engagement, program implementation, policy formulation, and implementation restrictions [23]. Document analysis used content analysis techniques to examine policy direction, plan-implementation consistency, and strategic achievement indicators. The study utilized qualitative data analysis software (e.g., NVivo) for organizing and coding the data.

Validity and Reliability Results

To ensure the validity of the results, triangulation was conducted across three data sources interviews, planning documents, and field observations [24]. Member checking with multiple key informants further strengthened the credibility of the findings. The research followed an iterative analytical process that moved thoughtfully to contextualize the policy's meaning and dynamics. The results were cross-verified through several rounds of analysis to ensure that the themes emerging from the data were valid and reflective of the respondents' perspectives.

Ethical Considerations

This research adhered to ethical guidelines throughout the study. Informed consent was obtained from all participants, ensuring their voluntary participation and understanding of the research purpose. The study also guaranteed confidentiality by anonymizing the interview data and ensuring that only the research team had access to the raw data. Ethical approval for the research was granted by the institutional review board.

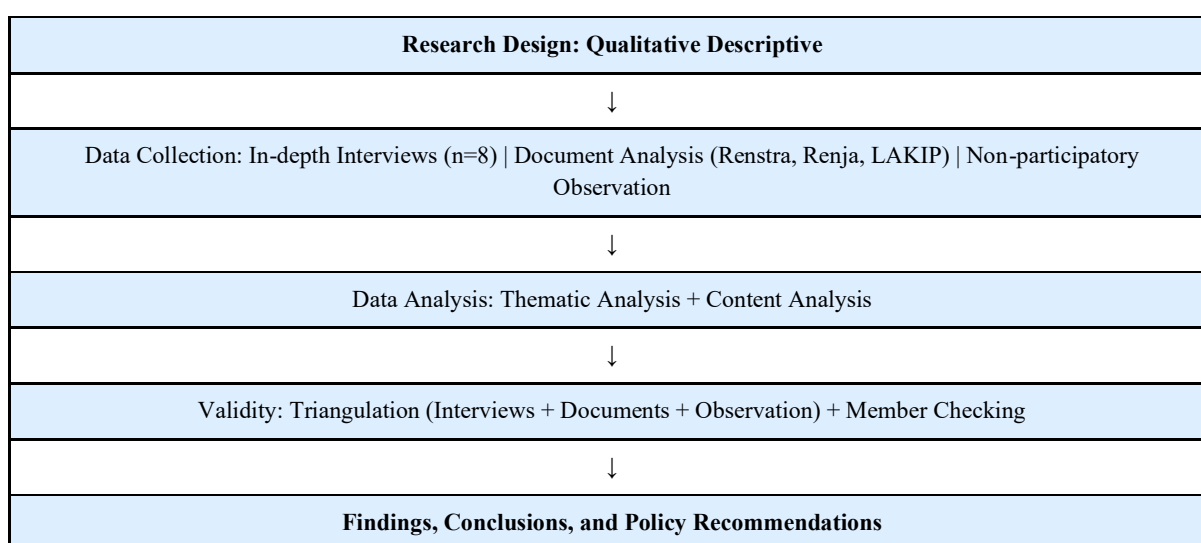


Figure 1. Research Methodology Flowchart

Table 3. Summary of Research Design

Component	Explanation
Research Approach	Descriptive qualitative research to comprehend public services-related digital literacy tactics.
Research Location	North Sumatra Province's Communication and Information Service (Diskominfo).
Research Focus	Digital literacy strategies in public services.
Data Collection Technique	Non-participatory observation, policy document analysis, and in-depth interviews with key informants (n=8).
Informant Selection	Community representatives (teachers, students, and digital farmers), SPBE implementation workers, and Diskominfo structural officials selected through purposive sampling.
Analysis Techniques	Thematic and content analysis combined with method and source triangulation.

Component	Explanation
Data Validity	Triangulation across interviews, documents, and observations; member checking to ensure interpretive accuracy.

RESULTS AND DISCUSSION

Digital Literacy Strategy in Regional Planning Documents

Digital literacy is one of the key pillars in the development of electronic-based public services. Official planning documents of the Communication and Informatics Agency (Diskominfo), such as the 2024–2026 Strategic Plan, the 2025 Work Plan, and the 2024 LAKIP, show that North Sumatra Province has begun to formulate digital literacy strategies within its public service reform agenda. These three documents serve as important sources for tracing policy directions, strategic programs, and local government achievements in strengthening the digital capacity of civil servants and the wider community.

The strengthening of digital literacy is generally included in the North Sumatra Communication and Informatics Office’s 2024–2026 Strategic Plan as part of its mission to support the province’s transition toward digital governance. The strategic objectives include increasing public participation in the use of digital technology and improving the quality of human resources in the ICT sector. Key initiatives include ICT training for civil servants, the development of online learning resources, and the strengthening of public information communities. However, the digital literacy approach in the Strategic Plan remains largely conceptual and lacks concrete performance indicators. This indicates that digital literacy has not yet been fully operationalized as a measurable strategic priority.

A more detailed description of implementation can be found in the 2025 Work Plan, which includes activities related to improving civil servants’ competence through SPBE training, managing government social media, and promoting the use of digital public services. The empowerment of Community Information Groups (KIM) is also included as a strategy for disseminating digital literacy across regions. However, these initiatives remain fragmented and have not been integrated into a comprehensive cross-sectoral digital literacy policy framework. This limitation is important because digital literacy should not only strengthen civil servants’ technical capacity and SPBE governance, but also expand access for socially vulnerable groups, including women, students in underdeveloped, frontier, and outermost (3T) areas, female MSME actors, the elderly, and communities with limited digital access.

The 2024 LAKIP provides an evaluation of program implementation and reports improvements in the provincial SPBE index and the use of public service applications. Nevertheless, important challenges remain, including civil servants’ limited understanding of digital systems, restricted access to digital literacy in remote areas, and weak cross-sectoral cooperation. These challenges indicate a significant gap between planning and implementation. More importantly, they also show that digital literacy strategies have not yet sufficiently addressed the needs of vulnerable groups who depend on digital access for education, social services, economic participation, and public information.

Table 4. Mapping of Digital Literacy Strategy in North Sumatra Diskominfo Planning Documents

Document	Digital Literacy Focus	Program Form	Analytical Notes
Renstra 2024–2026	Enhancing ICT-based capacity among civil servants and the community.	Civil servant training, educational platform development, public information community development.	Still conceptual; lacks measurable literacy indicators and has not explicitly addressed vulnerable groups such as women, students in 3T areas, the elderly, and communities with limited digital access.
Renja 2025	Digital public service training and facilitation.	SPBE training, social media management, community information empowerment.	Not yet organized within a comprehensive digital literacy framework that connects SPBE governance with inclusive access to education, public services, and social welfare.
LAKIP 2024	Evaluation of SPBE performance and digitalization program.	SPBE index improvement, growth of public applications, identification of implementation barriers.	System availability and user capacity remain misaligned, particularly for rural communities, female MSME actors, students, and socially vulnerable groups.

The mapping above shows that although digital literacy has been included in regional policy planning, it has not yet been developed as an integrated sectoral policy. The weakness of policy evaluation in this area is reflected in the absence of digital literacy indicators as key performance measures. The UNESCO digital literacy framework states that digital literacy policy should consider access to information, use of information, and information assessment, in addition to essential digital skills [25]. Martínez-Bravo [26] further emphasize that digital literacy is not limited to technical ability, but also involves critical understanding of digital information, innovation in digital environments, and ethical technology use.

Therefore, the digital literacy strategy in North Sumatra should be expanded beyond technical training for civil servants. It should also target digitally vulnerable groups, including

women, students in 3T areas, female MSME actors, the elderly, and communities that have not yet fully benefited from digital public services. This expansion is important to ensure that digital literacy contributes not only to bureaucratic efficiency and SPBE performance, but also to educational equity, women's economic participation, social inclusion, and improved access to welfare-related services.

These findings are consistent with document analysis supported by interviews with Diskominfo officials, who confirmed that digital literacy training predominantly reaches civil servants in major cities, while rural communities receive inadequate coverage. The data also show that only a small portion of the 14 regencies/cities with KIMs actively and consistently disseminate digital content. This condition underscores the unequal reach of current strategies and highlights the need for a more inclusive digital literacy policy that is responsive to the needs of women, students, rural communities, and other socially vulnerable groups.

Field Facts and Difficulties in the Digital Literacy Program's Implementation

On the ground, the digital literacy enhancement strategy is being progressively implemented, but document analysis, non-participatory observations, and in-depth interviews reveal that implementation has not yet produced optimal outcomes [12], [13]. Program implementation continues to face obstacles ranging from limitations in program design and human resource capacity to inadequate participation at the grassroots level.

Civil servants' training in the SPBE is one specific example. Through the 'ICT Human Resource Capacity Building' program, Diskominfo regularly trains civil servants in digital service platforms, information security principles, and emerging public service technologies. However, interviews with technical implementers revealed that the training remains narrowly technical, with participants primarily understanding 'digital' as referring to the use of work applications without engaging broader dimensions of cybersecurity, data management, or digital ethics. Falloon [25] asserts that digital literacy includes cognitive, social, and affective aspects of navigating the digital world in addition to technical skills.

Through the empowerment of Community Information Communities (KIM), digital literacy is also being implemented at the community level. KIM strengthening is positioned as a key tactic in the 2025 Work Plan for increasing access to digital information, especially in non-urban areas. However, interviews and observations of KIM social media suggest that the majority of KIMs remain largely passive, engaged primarily in administrative and ceremonial tasks with little structured digital literacy curriculum. The primary reasons for KIM's limited function as community-level digital hubs are a lack of continuous training, inadequate mentoring, and financial constraints.

Students and youth, who are key targets of digital literacy initiatives, have not received adequate attention. Teachers interviewed reported that available training mostly focuses on technical tools such as social media, Word, and Excel, ignoring social and cognitive aspects of digital literacy that are essential for developing critical thinking and ethical online conduct. Martínez-Bravo [26] contend that comprehensive digital literacy should incorporate technological, cognitive, and social elements to enable responsible information access, assessment, creation, and distribution.

Despite the availability of public service applications such as e-PPID, e-Database, and online complaint channels, their use remains modest. Official government channels are rarely

visited due to limited public awareness, while personal social media platforms predominate. Many operators serve primarily as data inputters without a thorough understanding of adaptive, user-oriented digital services restricting equitable digital change and public engagement.

Institutional obstacles further complicate implementation. As a cross-sectoral coordinator of digital policy rather than a direct technical service organization, Diskominfo lacks operational authority to mandate training across regional government agencies (OPD). A structural official confirmed: 'Diskominfo does not yet have the operational authority to dictate training outside its purview,' resulting in a sectoral, constrained, and disjointed approach that exacerbates the horizontal digital divide across districts and cities.

Table 5. The Digital Literacy Program's Implementation and Field Challenges

Implementation Aspects	Facts from the Field	Main Challenges
SPBE Training for ASN	Routinely implemented, but focused on application usage.	Absence of materials for strategic and interactive digital literacy.
KIM Empowerment	While the majority of KIMs are administrative and passive, some actively create material.	Low operating budget, lack of mentoring, and human resource capacity.
Student and Community Targets	Restricted to instruction in basic digital tools, mostly in cities.	Does not touch ethical, critical, or cultural aspects, nor does it reach peripheral areas.
Use of Public Service Applications	Although the program is operational and accessible, few users are making the most of it.	Insufficient socialization, lack of comprehension, and low trust in government platforms.
Cross-OPD Coordination	Diskominfo is not a technical implementer; it is merely a digital facilitator.	Lack of a coordinated cross-sectoral strategy and implementation fragmentation.

The actual state of North Sumatra's digital literacy program demonstrates that the strategy is still administrative and focused on formal activities rather than long-term changes in digital behavior. The programs emphasize activity outputs rather than the long-term effects on the community's and civil servants' digital capabilities. According to public policy theory, this state represents an implementation gap a discrepancy between the goals of policy and actual practice [27].

Field Facts and Difficulties in the Digital Literacy Program's Implementation

Structural Barriers

There is no solid institutional basis for digital literacy in North Sumatra. Despite being the leading sector, Diskominfo has only coordinating authority over cross-sectoral digital literacy programs, without executive or regulatory power. As a result, technical regional apparatus organizations (OPDs) are not required to integrate digital literacy initiatives into sectoral

services such as social, health, or education. The 2024–2026 Strategic Plan and the 2025 Work Plan contain no explicit requirement to engage other OPDs in enhancing digital literacy for the general population or civil officials.

The absence of a Governor's Regulation (Pergub) or Regional Regulation (Perda) explicitly addressing digital literacy improvement is a major flaw. Without such a regulatory foundation, digital literacy strategies remain only indicative and must be implemented through sectoral initiatives and annual budget availability. A structural official stated: 'The program cannot function without a budget implementation document (DPA). This frequently occurs as a result of the lack of cross-sectoral emphasis on digital literacy.'

Coordination and sustainability are further issues. Due to an annual or project-based methodology, digital literacy lacks a well-organized long-term plan. Program evaluations typically only record the quantity of training sessions or participants, rather than quantifying changes in digital behavior or the effect on public services contrary to performance-based governance approaches that emphasize outcome-based metrics [28].

Cultural Barriers

North Sumatra's bureaucracy continues to exhibit cultural resistance to digital transformation. Many civil personnel, particularly those working outside the provincial capital, do not regard digital literacy as a necessary professional skill. Digital applications are seen as an additional burden rather than an efficiency tool, and digital training is often taken as a formality rather than internalized into workplace culture.

The hierarchical bureaucratic culture also slows digital implementation. Operational employees typically only execute technical directives, while structural officials make all decisions and innovations. Digital literacy, however, requires individual initiative, collaborative work patterns, and adaptability qualities that conflict with traditional bureaucratic culture.

At the community level, despite relatively high internet penetration in urban North Sumatra, social media and entertainment dominate usage. Critical literacy remains low people rarely check information, are unfamiliar with digital rights, and are more likely to trust WhatsApp groups than official government websites. Government apps are perceived as less user-friendly, formal, and slow. Moreover, many consumers still prefer in-person office visits due to doubts about the reliability of service applications, reflecting a lack of public trust in government digital systems.

Table 6. Structural and Cultural Challenges of Digital Literacy in North Sumatra

Dimensions of Challenge	Key Findings	Impact on Digital Literacy
Structural	Diskominfo has only coordinating functions; no laws govern cross-OPD literacy.	Strategy is not institutionally embedded; implementation is irregular.
Institutional	No long-term plan exists; evaluation relies on administrative outputs only.	Programs are unsustainable with no effect on changing digital behavior.

Dimensions of Challenge	Key Findings	Impact on Digital Literacy
Bureaucratic Culture	Civil servants resist digital innovation; literacy is understood only technically.	Low system adoption and a lack of service-oriented work culture.
Community Culture	Digital devices are used mainly for entertainment; low use of public digital platforms.	The public lacks digital literacy; public service applications are underutilized.
Public Trust	Doubts regarding the digital governance framework; mistrust of program reliability.	People use traditional methods and are hesitant to adopt digital solutions.

These findings resonate with the literature: creating a digital culture embedded in social life, education, and services is necessary to build digital literacy it cannot be achieved merely by offering access or technical training [29]. Gilbert [30] further underlined how critical it is to address the utilization gap the differences in how effectively people from different social groups and geographical areas can use technology.

Digital Literacy Strategy's Effect on Public Service Quality

The effectiveness of public services in the digital era depends not only on technological infrastructure but also on the digital literacy of key actors, including civil servants and the public. This approach has been implemented in North Sumatra through training and the creation of online service systems, as described in planning documents. However, its ability to meaningfully raise the standard of public services remains limited.

The increase in the SPBE Index in the 2024 LAKIP indicates advancements in digital system integration and infrastructure. Applications including e-Database, e-PPID, and online complaint channels have been created to increase public engagement and information access. Yet interviews and observations show that civil servants' use of applications is still administrative, primarily for reporting rather than interactive engagement. Systems are not yet utilized as instruments for participatory and responsive service delivery.

At the community level, digital literacy has not yet significantly altered service access patterns. While urban dwellers are generally more accustomed to using online services, rural residents, the elderly, and vulnerable groups continue to rely on traditional techniques. A digital literacy community informant noted that government service applications are sometimes well-designed, but citizens lack knowledge of how to use them or are uncertain about how their data will be used exemplifying the 'usage gap' described by Meyers et al. [29], which refers to the discrepancy between technological advancement and user preparation.

Citizen participation in tracking and reporting public services has also not been fully impacted by digital literacy initiatives. Despite digital platforms such as social media and official government websites, public involvement remains low, and informal channels are more frequently used to file concerns. Consequently, technology-based feedback and quality control mechanisms are not functioning optimally missing a key opportunity for inclusive digital governance [31].

Table 7. Digital Literacy Strategy's Effect on North Sumatra Province's Public Service Quality

Service Quality Aspects	Observed Positive Impacts	Obstacles and Gaps Found
Service Efficiency	Some services are faster through online applications.	ASN has not optimally integrated digital systems into routine work.
Service Accessibility	Applications can be accessed by urban communities with internet access.	Vulnerable populations and remote areas continue to lag behind in access.
Public Information Transparency	Information is published through e-PPID and other official channels.	Lack of digital literacy prevents users from accessing or comprehending information.
Community Participation	Online interactions and digital complaint channels are accessible.	Active community involvement in digital systems remains limited.
Public Service Satisfaction	Some people find certain applications beneficial.	Many people choose manual processes due to low trust in digital systems.

The aforementioned results show that the digital literacy policy has improved public services in certain respects, but its effects are still unequal and restricted. This supports Voulvoulis [32] argument that the digital transformation of public services is a component of a broader societal change that requires a paradigm shift not only a systemic one. Without a transformative approach, digitalization risks becoming merely a bureaucratic formality rather than a mechanism for truly inclusive and responsive service delivery.

Strategy Gaps and Recommendations for Improving Digital Literacy

Strategy Design and Implementation Gap

Planning documents position digital literacy as an essential component of SPBE and technology-based public services. However, these policy designs remain largely normative and lack performance metrics capable of measuring digital transformation holistically, including behavioral changes among public officials and the general public. Performance evaluation still focuses mainly on administrative outputs, such as the number of training sessions, applications created, or social media accounts maintained, rather than qualitative improvements in the quality of digital interaction and public service responsiveness.

Moreover, cross-sectoral policy initiatives have not fully integrated digital literacy into broader public service agendas. As the leading sector, Diskominfo lacks the functional authority to encourage other OPDs to coordinate digital literacy initiatives across licensing, education, health, and social welfare services. This fragmentation creates a gap between macro-level strategies at the provincial level and micro-level implementation within each OPD. The absence of regional regulations, such as a Governor's Regulation or a specific Regional Regulation on digital literacy, means that Diskominfo bears primary responsibility, while the

regional government as a whole has not yet shared this commitment institutionally. This condition also limits the extent to which digital literacy strategies can address the needs of specific social groups, particularly women, students, and vulnerable communities who depend on accessible digital public and social services.

Lack of Capacity and Program Coverage

Digital literacy training has focused predominantly on ASN and particular community groups, such as MSMEs and KIMs, while vulnerable groups in underserved areas, including communities in 3T regions, persons with disabilities, the elderly, women, students, and digitally marginalized communities, have not yet been adequately reached. Field research confirms that ASN training remains limited, non-hierarchical, and disconnected from the practical challenges of digital services in districts and cities located far from the provincial capital. People outside official community groups often lack adequate information or guidance regarding their rights, responsibilities, and ethical conduct in the digital sphere. This situation worsens the digital divide across social groups and geographical areas [33]. More broadly, gaps in access, capacity, and the use of digital services do not only affect the effectiveness of public governance, but also have implications for women's access to public information, students' access to digital learning resources, and vulnerable communities' ability to benefit from digital social welfare services.

Impact Gap on Service Quality

Despite their availability, digital applications have had a limited impact on public service standards. Field interviews and the LAKIP document confirm that the public has not yet experienced significant improvements in service responsiveness and efficiency. Applications are often used only for data input rather than for producing fast, accurate, and user-friendly service outputs. Without a feedback loop between users and service providers, digital systems cannot adapt to real public needs. Civil servants themselves do not yet fully understand collaborative and interactive digital service delivery, and a digital civic culture that promotes transparency, innovation, and accountability has not yet been institutionalized [34].

This limited impact is particularly important for socially vulnerable groups. Women, students, rural communities, the elderly, persons with disabilities, and low-income groups may face greater barriers when public service applications are available but not accompanied by sufficient literacy, assistance, and trust-building mechanisms. As a result, digital transformation risks benefiting only users who already possess adequate access and digital competence, while leaving behind communities that rely most heavily on education, health, social protection, and welfare-related digital services.

Recommendations for Strengthening Digital Literacy Strategies

Based on the identified gaps, the following multi-dimensional recommendations are proposed:

1. **Binding and Inclusive Regulations:** The regional government must draft a Regional Regulation or Governor's Regulation that comprehensively governs digital literacy across civil servants, the public, regional government agencies, and the business community. This regulation should include clear cross-sectoral mandates and explicitly

address the digital inclusion needs of women, students, persons with disabilities, the elderly, and vulnerable communities.

2. **Competency-Based Digital Literacy Curriculum:** Technical training must be complemented by critical, ethical, and participatory components. These components should include the ability to evaluate information, protect personal data, understand digital security, and use digital channels to communicate civic needs and access public services responsibly.
3. **Socially and Regionally Inclusive Digital Inclusion:** Literacy campaigns and training must target vulnerable and marginalized populations using culturally relevant methods. Special attention should be given to women, students in underserved areas, female MSME actors, the elderly, persons with disabilities, and rural communities to ensure equitable access beyond urban areas.
4. **Outcome-Based Evaluation:** Strategy effectiveness must be assessed through behavioral changes, service satisfaction, increased public digital engagement, and improved access to education and social welfare services, not merely by counting activities, applications, or participants.
5. **Multi-Stakeholder Collaboration:** The government must collaborate with academics, digital communities, the media, civil society organizations, women’s groups, educational institutions, and the private sector to broaden the scope of digital education and create a sustainable literacy ecosystem.

Table 8. Strategic Deficits and Recommendations for Enhancing Digital Literacy in North Sumatra Province

Dimensions of Gap	Key Findings	Strategic Recommendations
Strategy and Indicator Design	Policy evaluation prioritizes administrative outputs over changes in digital behavior and inclusive access.	Create behavioral assessments and digital competency indicators that also measure access among women, students, and vulnerable communities.
Coordination and Regulation	No regional regulation; Diskominfo lacks cross-sectoral authority.	Draft regional regulations applicable to all OPDs and related sectors, including education, health, social welfare, and women’s empowerment
Program Coverage	Remote communities, rural civil servants, women, students, the elderly, and vulnerable groups have less access to training.	Expand training reach in a socially, regionally, and inclusively targeted manner.
Impact on Public Services	Service quality and satisfaction have not significantly improved as a result of application deployment.	Align user-driven service reform with digital literacy outcomes, especially for users dependent on education, social protection, and welfare-related services.

Dimensions of Gap	Key Findings	Strategic Recommendations
Engagement and Innovation	Citizen and civil servant participation in digital service innovation remains limited.	Create a collaborative, multi-stakeholder digital culture involving government, communities, educational institutions, women's groups, and civil society.

The gaps identified demonstrate that digital transformation in public services is a complicated undertaking of institutional and societal change rather than merely a technocratic procedure. Digital literacy is a crucial precondition for digital breakthroughs to progress beyond infrastructure and applications and genuinely integrate into the public's everyday lives and bureaucratic work culture. Without broad and comprehensive digital literacy, digital transformation risks exacerbating social inequality and reducing the quality of public services [35].

Future research should adopt a comparative approach across multiple provinces to examine how different governance structures, demographic profiles, and resource allocations shape digital literacy outcomes in Indonesia. Quantitative or mixed-methods studies measuring actual changes in digital behavior and public service satisfaction would complement the findings of this study. Additionally, research exploring the role of private sector partnerships and national digital literacy programs in supporting subnational implementation would enrich the policy evidence base.

CONCLUSION

This study reveals that North Sumatra Province has demonstrated an initial commitment to technology-based public service reform by incorporating digital literacy into planning documents, such as the Strategic Plan (Renstra) and Work Plan (Renja). However, significant gaps remain between policy objectives and implementation practices. Digital literacy has not yet been systematically integrated into public behavior or bureaucratic work culture. Training remains dominated by technical aspects, its coverage is still uneven, and its impact on public service quality remains suboptimal. Three main findings emerge from this study. First, digital literacy strategies in North Sumatra have been included in regional planning documents, but they still lack cross-sectoral regulatory force, measurable performance indicators, and integration into a comprehensive policy framework. Second, implementation continues to be constrained by structural barriers, such as the limited institutional authority of Diskominfo, the absence of binding regulations, and fragmented coordination; as well as cultural barriers, including bureaucratic resistance, community passivity, and low public trust in government digital platforms. Third, although there have been improvements in SPBE infrastructure and application availability, their impact on public service quality remains limited, particularly for vulnerable groups in rural and remote areas, including women, students, the elderly, persons with disabilities, and communities that depend on digital social services, due to the usage gap between system availability and user readiness. The provision of inclusive and digitally responsive public services is hindered by these gaps in strategy, institutions, and user capacity.

Digital literacy has not yet developed into an instrument for citizen empowerment or bureaucratic reform. Therefore, cross-sectoral regulations, a critical competency-based curriculum, outcome-based evaluation, and multi-stakeholder engagement are needed to advance digital literacy strategies.

LIMITATIONS

This study has several limitations. First, it is restricted to the provincial level and does not comprehensively address the role of national government initiatives and private sector partners in shaping digital literacy outcomes. Second, the qualitative approach limits statistical generalizability across other provinces or contexts. Third, the study relies primarily on Diskominfo planning documents (Renstra, Renja, LAKIP) and interviews with purposively selected informants, which may not capture all dimensions of digital literacy implementation across the province's diverse districts and cities.

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CONFLICT OF INTEREST

"The authors declare no conflict of interest."

DECLARATION OF USE OF AI IN SCIENTIFIC WRITING

The authors used ChatGPT during the preparation of this work to design graphics and images. After utilizing the tool, the authors thoroughly reviewed and edited the content as necessary, assuming full responsibility for the publication's content.

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