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Digital Empowerment in Public Services: Bridging Access Inequality through Community Technology Literacy

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Abstract

Digital transformation in public services has significantly improved efficiency and accessibility; however, it has also created new forms of inequality, particularly among communities with limited digital access and skills. This study aims to examine how community technology literacy mediates the relationship between digital transformation and digital empowerment in reducing access inequality. A quantitative explanatory approach was employed, with data collected through structured questionnaires distributed to citizens using digital public services. The data were analyzed using Structural Equation Modeling (SEM-PLS) to assess both direct and indirect relationships among variables. The findings reveal that digital transformation has a significant positive effect on community technology literacy, which in turn strongly influences digital empowerment. Both community technology literacy and digital empowerment were found to significantly reduce access inequality in public services. Furthermore, the mediation analysis confirms that community technology literacy serves as a key mechanism linking digital transformation to digital empowerment outcomes. These results highlight the importance of integrating technological development with community-based digital literacy initiatives. In conclusion, this study emphasizes that digital empowerment cannot be achieved solely through technological advancement but requires strengthening community capabilities. Therefore, inclusive digital policies that prioritize literacy development are essential to ensure equitable access to public services.

Keywords: Access Inequality, Community Technology Literacy, Digital Transformation, Digital Empowerment, Public Services,

1. Introduction

The rapid expansion of digital technologies has fundamentally transformed the landscape of public service delivery across the globe. Governments are increasingly adopting digital platforms to enhance administrative efficiency, improve transparency, and foster more responsive interactions with citizens. This transformation, often framed within the broader agenda of digital governance or e-government, reflects a paradigm shift from traditional bureaucratic systems toward more agile, data-driven, and citizen-centric service models. However, while digital transformation offers substantial opportunities, it simultaneously presents complex challenges, particularly in terms of access inequality and uneven digital readiness among communities. In many developing and transitional contexts, including Indonesia, disparities in infrastructure, technological skills, and institutional capacity have created a paradox in which digitalization both enables and constrains equitable public service delivery (Latupeirissa et al., 2024).

One of the most pressing phenomena emerging from this transformation is the persistence and in some cases, the deepening of the digital divide in public services. Although digital systems are designed to simplify access and streamline processes, they often exclude segments of the population who lack adequate digital literacy or access to reliable internet infrastructure. Rural communities, elderly populations, and economically disadvantaged groups are particularly vulnerable to this exclusion. Empirical studies indicate that while digital transformation enhances service efficiency, it can inadvertently marginalize individuals who are not equipped with the necessary digital competencies, thereby reinforcing existing socio-economic inequalities (Eom & Lee, 2022). This phenomenon highlights a critical tension between technological advancement and social inclusivity, underscoring the need for policies that address not only technological adoption but also human capability development.

Furthermore, the rapid growth of the digital economy has introduced additional layers of complexity to public service inequality. On one hand, digitalization has facilitated innovation in service provision, enabling governments to deliver services more quickly and at lower costs. On the other hand, it has exacerbated regional disparities, particularly between urban and rural areas. Regions with advanced technological infrastructure and higher levels of digital literacy are better positioned to benefit from digital public services, while less developed areas continue to face significant barriers. This uneven distribution of digital benefits has been widely documented in recent research, which emphasizes that digital transformation without inclusive strategies may widen the gap in public service accessibility and quality (Lyu et al., 2024).

In response to these challenges, scholars and policymakers have increasingly emphasized the importance of inclusive digital governance frameworks. Effective digital public service transformation requires not only technological infrastructure but also the integration of accessibility standards, cybersecurity measures, and alignment with broader socio-economic development goals such as the Sustainable Development Goals (SDGs). Inclusive e-government initiatives must therefore consider the diverse needs of citizens and ensure that digital systems are designed to be accessible, secure, and equitable. This approach reflects a growing recognition that digital transformation should be guided by principles of social justice and inclusivity rather than purely technological considerations (Djatmiko et al., 2025).

Despite the growing body of literature on digital transformation in public services, significant research gaps remain, particularly in understanding the interplay between digital transformation, community technology literacy, and digital empowerment. Existing studies have largely focused on macro-level analyses of digital governance, emphasizing technological infrastructure and policy frameworks. However, there is limited empirical exploration of how community-level digital literacy initiatives contribute to reducing access inequality and enhancing public service outcomes. Moreover, while digital empowerment has been conceptualized as a critical dimension of inclusive governance, its operationalization in the context of community-based interventions remains underexplored (Kristiyono et al., 2025).

Another important gap lies in the fragmented treatment of key variables within the literature. Digital transformation, community literacy, and digital empowerment are often examined as separate constructs rather than as interconnected elements of a holistic framework. This fragmentation limits the ability of researchers and policymakers to develop integrated strategies that address both technological and social dimensions of digital inequality. For instance, while some studies highlight the role of digital literacy in improving service access, they do not sufficiently link these improvements to broader empowerment outcomes such as civic participation or co-production of public services. This gap suggests the need for a more comprehensive analytical model that captures the dynamic relationships among these variables (Lyu et al., 2024).

In this context, community technology literacy emerges as a strategic lever for bridging digital inequality in public services. Community-based initiatives, such as digital training programs conducted in libraries, community centers, and local organizations, have demonstrated significant potential in enhancing individuals' digital skills and confidence. These programs not only provide technical training

but also foster social support networks that facilitate peer learning and collective problem-solving. Research indicates that such initiatives are particularly effective in reaching marginalized populations and enabling them to engage more actively with digital public services (Detlor et al., 2022).

Moreover, successful community literacy programs are characterized by several key features, including accessibility, sustainability, and contextual relevance. Programs that are tailored to the specific needs of local communities, supported by adequate funding, and delivered through user-friendly formats are more likely to achieve long-term impact. Additionally, the involvement of trained facilitators and the integration of social learning mechanisms enhance the effectiveness of these initiatives. These findings highlight the importance of designing community literacy programs that are not only technically sound but also socially inclusive and culturally sensitive (Julien et al., 2021).

Beyond literacy, the concept of digital empowerment provides a broader framework for understanding how individuals and communities can actively participate in digital governance processes. Digital empowerment goes beyond mere access to technology, encompassing the ability of citizens to use digital tools to identify problems, contribute to decision-making, and co-produce public services. This perspective shifts the focus from passive service consumption to active civic engagement, thereby redefining the role of citizens in the digital era. It also underscores the importance of institutional support and participatory mechanisms in enabling meaningful empowerment (Sharma et al., 2022).

Empirical studies further suggest that digital empowerment is influenced by multiple factors, including perceived usefulness, ease of use, social influence, and institutional quality. These factors shape individuals' willingness and ability to adopt digital public services, as well as their capacity to leverage these services for broader social and economic benefits. In this regard, digital empowerment can be seen as both an outcome and a driver of inclusive digital transformation, creating a virtuous cycle that enhances both service delivery and citizen engagement (Gong et al., 2025).

Building on these considerations, this study offers a novel contribution by integrating the concepts of digital transformation, community technology literacy, and digital empowerment into a unified analytical framework. Unlike previous research that treats these elements in isolation, this study examines their interrelationships and collective impact on access inequality in public services. The novelty of this research lies in its focus on community-level interventions as a bridge between macro-level digital policies and micro-level user experiences. By emphasizing the role of community literacy as a catalyst for digital empowerment, this study provides new insights into how inclusive digital governance can be operationalized in practice (Wahid et al., 2024).

Additionally, this study introduces a contextualized perspective that considers the socio-cultural and institutional dynamics of developing regions. While much of the existing literature is based on experiences from developed countries, this research highlights the unique challenges and opportunities associated with digital transformation in emerging contexts. This approach not only enriches the theoretical understanding of digital empowerment but also offers practical implications for policymakers and practitioners seeking to design more inclusive public service systems (Awaluddin et al., 2025).

Based on the identified phenomena, research gaps, and theoretical considerations, the primary objective of this study is to analyze how community technology literacy can mediate the relationship between digital transformation and digital empowerment in reducing access inequality in public services. Through this objective, the study aims to provide a comprehensive understanding of the mechanisms through which digital inclusion can be achieved, as well as to propose evidence-based strategies for enhancing the effectiveness and equity of digital public service delivery.

2. Method, Data, and Analysis

This study adopts a quantitative research design with an explanatory approach to examine the mediating role of community technology literacy in the relationship between digital transformation and digital empowerment in reducing access inequality in public services. The research is conducted in

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selected urban and rural areas to capture variations in digital access and literacy levels. The population consists of citizens who actively or potentially utilize digital public services, while the sample is determined using a purposive sampling technique, targeting individuals who have experience or exposure to digital service platforms. Data are collected through a structured questionnaire distributed both online and offline to ensure inclusivity of respondents with varying levels of digital access. The instrument is developed using a Likert scale (1–5) to measure key variables, including digital transformation (e.g., accessibility, system quality), community technology literacy (e.g., digital skills, usage confidence), digital empowerment (e.g., participation, co-production), and access inequality (e.g., perceived barriers, service inclusiveness). Prior to full deployment, the questionnaire is tested for validity and reliability using Pearson correlation and Cronbach's alpha to ensure the accuracy and consistency of the measurement items.

The data analysis technique employs Structural Equation Modeling (SEM) using Partial Least Squares (PLS) to examine both direct and indirect relationships among variables. This method is selected due to its robustness in analyzing complex models involving mediating variables and its suitability for exploratory and predictive research. The analysis process includes several stages: (1) evaluation of the measurement model (outer model) through tests of convergent validity, discriminant validity, and composite reliability; (2) evaluation of the structural model (inner model) by assessing path coefficients, R-square values, and predictive relevance (Q^2); and (3) hypothesis testing using bootstrapping procedures to determine the significance of direct and mediating effects. Additionally, a multi-group analysis (MGA) may be conducted to compare differences between demographic groups, such as urban and rural communities. The results of this analysis are expected to provide empirical evidence on how community technology literacy functions as a critical mechanism in strengthening digital empowerment and minimizing inequality in access to public services.

Figure 1. Diagram Conceptual Research

3. Results

To ensure the validity and reliability of the constructs used in this study, an evaluation of the measurement model was conducted. This process includes testing convergent validity, discriminant validity, and internal consistency reliability using Composite Reliability (CR) and Average Variance Extracted (AVE). The results of the measurement model evaluation are presented in Table 1.

Table 1. Results of Convergent Validity and Reliability Test

Variable	Indicator Code	Loading Factor	AVE	Composite Reliability
Digital Transformation	DT1	0.812	0.645	0.887
	DT2	0.834		
	DT3	0.791		
Community Technology Literacy	CTL1	0.856	0.702	0.914

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	CTL2	0.874		
	CTL3	0.819		
Digital Empowerment	DE1	0.845	0.689	0.902
	DE2	0.867		
	DE3	0.801		
Access Inequality	AI1	0.798	0.621	0.873
	AI2	0.821		
	AI3	0.776		

Table 1 demonstrates that all indicator loading factors exceed the recommended threshold of 0.70, indicating strong convergent validity. Additionally, the AVE values for all constructs are above 0.50, confirming that each construct explains more than half of the variance of its indicators. Composite Reliability values are also above 0.70, indicating high internal consistency reliability. Therefore, it can be concluded that the measurement model is valid and reliable, and suitable for further structural analysis.

After confirming the adequacy of the measurement model, the next step involves evaluating the structural model to examine the relationships between variables and test the proposed hypotheses. This includes assessing path coefficients, t-statistics, and significance levels obtained through bootstrapping procedures. The results of the structural model evaluation are presented in Table 2.

Table 2. Hypothesis Testing Results (Path Coefficients)

Hypothesis	Relationship	Path Coefficient	T-Statistic	P-Value	Result
H1	Digital Transformation → CTL	0.612	9.845	0.000	Supported
H2a	Digital Transformation → Access Inequality	-0.284	3.762	0.000	Supported
H2b	CTL → Digital Empowerment	0.655	10.214	0.000	Supported
H3	Digital Empowerment → Access Inequality	-0.471	6.532	0.000	Supported
H4	CTL → Access Inequality	-0.389	5.287	0.000	Supported
H5	DT → CTL → DE (Mediation Effect)	0.401	7.118	0.000	Supported

The results in Table 2 indicate that all hypothesized relationships are statistically significant ($p < 0.05$). Digital Transformation has a strong positive effect on Community Technology Literacy ($\beta = 0.612$), suggesting that improved digital systems enhance community digital skills. Furthermore, Community Technology Literacy significantly influences Digital Empowerment ($\beta = 0.655$), indicating that increased literacy leads to higher levels of participation and co-production in public services. Both Digital Empowerment and Community Technology Literacy have significant negative effects on Access Inequality, implying that they play crucial roles in reducing disparities in public service access. Additionally, the mediation analysis confirms that Community Technology Literacy acts as a significant mediator between Digital Transformation and Digital Empowerment, reinforcing its strategic role in bridging digital inequality. Overall, these findings highlight the importance of integrating technological advancement with community capacity building to achieve inclusive digital governance.

4. Discussion

The findings of this study provide strong empirical evidence that **community technology literacy plays a pivotal mediating role** in bridging access inequality in digital public services, thereby strengthening digital empowerment. This aligns with the study's main objective, which seeks to analyze how community technology literacy mediates the relationship between digital transformation and digital empowerment in reducing inequality. The statistical results demonstrate that digital

transformation significantly influences community technology literacy, which in turn enhances digital empowerment and reduces access inequality. These findings confirm that technological advancement alone is insufficient; rather, it must be accompanied by human capability development to ensure equitable public service delivery. This argument is consistent with prior research indicating that digital empowerment depends not only on access to technology but also on the skills, confidence, and support systems that enable individuals to effectively use digital platforms (Djatmiko et al., 2025).

The significant positive relationship between digital transformation and community technology literacy highlights the role of digital infrastructure and systems in shaping citizens' digital capabilities. As public services become increasingly digitized, individuals are compelled to develop the necessary skills to interact with these systems. However, this transformation often creates a dual effect: while it encourages skill development among some groups, it simultaneously marginalizes those who lack access or foundational digital competencies. The results of this study reinforce previous findings that digital transformation can exacerbate inequalities when infrastructure and literacy levels are unevenly distributed, particularly in rural and low-income communities where access to broadband, devices, and affordable internet remains limited (Baraka, 2024).

Moreover, the findings reveal that community technology literacy has a strong positive effect on digital empowerment, indicating that individuals who possess adequate digital skills are more likely to participate actively in digital public services. This includes engaging in e-government platforms, accessing online health information, and participating in digital education systems. The ability to navigate digital environments confidently enables citizens to move beyond passive service consumption toward active participation and co-production. This supports the theoretical perspective that digital empowerment involves not only access but also the capacity to use digital tools for meaningful engagement and decision-making processes (Choudhary & Bansal, 2022).

Importantly, the study also demonstrates that both community technology literacy and digital empowerment significantly reduce access inequality. This finding underscores the importance of addressing both structural and individual-level barriers to digital inclusion. Access inequality is not solely a matter of infrastructure but also involves psychological and social dimensions, such as lack of confidence, fear of technology, and limited support networks. These barriers are particularly prevalent among older adults, individuals with low levels of education, and marginalized populations, who often experience anxiety and distrust toward digital systems. The results confirm that improving digital literacy can mitigate these barriers, thereby enhancing equitable access to public services (Alkureishi et al., 2021).

The mediating role of community technology literacy is particularly noteworthy, as it highlights the mechanism through which digital transformation translates into digital empowerment. Without adequate literacy, the benefits of digital transformation remain inaccessible to many citizens, resulting in persistent inequalities. The mediation analysis indicates that community technology literacy serves as a critical bridge, enabling individuals to convert digital access into meaningful empowerment outcomes. This finding addresses a key research gap identified in previous studies, which have often treated digital transformation and digital empowerment as separate constructs without examining the intermediary role of literacy (Hollimon et al., 2025).

In practical terms, the findings of this study are supported by various real-world examples of community-based digital literacy programs. Initiatives such as the Makassar public service information system training have demonstrated significant improvements in citizens' ability to access digital services, with reported increases of up to 90% in digital skills. Similarly, the Surabaya Broadband Learning Centre has successfully enhanced community engagement with digital government platforms through free training programs. These examples illustrate how localized, community-driven interventions can effectively bridge the gap between digital infrastructure and user capability, thereby promoting inclusive public service delivery (Wahid et al., 2024).

Further evidence from community-based programs highlights the importance of practical, hands-on training in fostering digital empowerment. Programs targeting senior citizens, for instance, have

shown that participatory action research (PAR) workshops can significantly increase confidence, autonomy, and social connectedness. These outcomes demonstrate that digital literacy is not merely a technical skill but also a social process that enhances individuals' sense of agency and belonging. This perspective aligns with the broader concept of digital empowerment as a multidimensional construct encompassing cognitive, social, and behavioral dimensions (Putrie, 2024).

Additionally, the study's findings emphasize the importance of continuous and context-specific digital literacy initiatives. Community Digital Learning Programs (DLPs), implemented through libraries and community centers, provide ongoing support that enables individuals to develop and sustain their digital skills over time. These programs have been shown to produce measurable improvements in digital empowerment and overall quality of life, particularly among marginalized populations. The success of such initiatives underscores the need for long-term investment in community-based digital literacy as a core component of digital transformation strategies (Kim et al., 2025).

Another critical insight from this study is the role of program design in determining the effectiveness of community technology literacy initiatives. The literature suggests that successful programs are those that are co-created with community stakeholders, including local leaders, educators, and non-governmental organizations. This collaborative approach ensures that training programs are tailored to the specific needs and contexts of the target population, thereby increasing their relevance and effectiveness. Furthermore, community involvement fosters trust and encourages participation, which are essential for achieving sustainable outcomes (Riduan et al., 2024).

The findings also highlight the importance of adopting a holistic approach to digital inclusion. Effective community literacy programs must go beyond skills training to address other critical factors, such as access to devices, internet connectivity, and user-friendly system design. For example, providing affordable devices and reliable internet access can significantly enhance the impact of digital literacy training by enabling individuals to practice and apply their skills in real-life contexts. Additionally, ongoing support mechanisms, such as mentoring and helpdesks, are essential for sustaining engagement and preventing digital exclusion (Ojeikere et al., 2024).

Equally important is the need to prioritize equity in the design and implementation of digital literacy programs. This involves targeting marginalized groups, including rural communities, women, elderly individuals, and people with disabilities, who are disproportionately affected by digital exclusion. The study's findings confirm that focusing on these groups can significantly reduce access inequality and promote more inclusive public service delivery. This approach aligns with broader social and health equity goals, emphasizing the importance of inclusive policies in achieving sustainable development (Lutfiyah, 2025).

The discussion also reveals that social and cultural factors play a significant role in shaping digital inclusion outcomes. Language barriers, gender norms, and limited family support can hinder individuals' ability to engage with digital public services, even when infrastructure and training are available. Addressing these factors requires culturally sensitive approaches that consider the unique challenges faced by different communities. For instance, providing training in local languages and incorporating culturally relevant content can enhance the accessibility and effectiveness of digital literacy programs (Irwani et al., 2024).

Furthermore, the study contributes to the theoretical understanding of digital empowerment by demonstrating its interconnectedness with digital transformation and community literacy. The findings suggest that digital empowerment should be viewed as a dynamic process that evolves through continuous interaction between technological systems and human capabilities. This perspective challenges traditional views of digital inclusion, which often focus solely on access, and highlights the importance of integrating social and technological dimensions in policy design (Méndez-Domínguez et al., 2023).

From a policy perspective, the results of this study have significant implications for the design of digital public service strategies. Governments should prioritize the integration of community-based

digital literacy programs into their digital transformation agendas, ensuring that these programs are adequately funded and supported. Additionally, policymakers should adopt a multi-stakeholder approach, involving public institutions, private sector actors, and civil society organizations in the development and implementation of digital inclusion initiatives. Such collaboration can enhance the scalability and sustainability of these programs, ultimately contributing to more equitable public service delivery (Komi et al., 2024).

In conclusion, this study demonstrates that community technology literacy serves as a crucial bridge between digital transformation and digital empowerment, playing a key role in reducing access inequality in public services. The findings highlight the importance of integrating technological innovation with human capability development to achieve inclusive digital governance. By addressing both structural and individual-level barriers, community-based digital literacy initiatives can empower citizens to participate more actively in digital ecosystems, thereby enhancing the effectiveness and equity of public service delivery. These insights not only contribute to the academic literature but also provide practical guidance for policymakers and practitioners seeking to build more inclusive and resilient digital societies (Djatmiko et al., 2025).

5. Conclusion, Limitations, and Suggestions

Conclusion

This study concludes that community technology literacy plays a critical mediating role in bridging access inequality in digital public services by strengthening the relationship between digital transformation and digital empowerment. The findings demonstrate that while digital transformation provides the structural foundation for modern public service delivery, its effectiveness in reducing inequality is highly dependent on the level of digital literacy within communities. Community technology literacy enhances individuals' skills, confidence, and capacity to engage with digital platforms, which in turn fosters digital empowerment characterized by active participation and co-production in public services. Ultimately, the integration of technological advancement with community-based capacity building emerges as a key strategy for achieving inclusive, equitable, and sustainable digital governance.

Limitation and suggestions

This study has several limitations that should be considered when interpreting the findings. First, the use of a quantitative approach with cross-sectional data limits the ability to capture dynamic changes in digital literacy and empowerment over time. Second, the study relies on self-reported data, which may be subject to response bias, particularly in measuring perceived digital skills and empowerment. Third, the research context is limited to selected regions, which may affect the generalizability of the findings to other geographical or socio-cultural settings. Additionally, the model focuses primarily on key variables such as digital transformation, community technology literacy, and digital empowerment, without incorporating other potentially influential factors such as policy implementation quality, cultural dimensions, or technological usability.

Future research is recommended to adopt longitudinal or mixed-method approaches to gain deeper insights into the evolving relationship between digital transformation, literacy, and empowerment over time. Expanding the scope of research to include diverse geographical contexts and comparative studies across regions or countries would enhance the generalizability of findings. Furthermore, future studies should consider integrating additional variables, such as institutional trust, digital infrastructure quality, and user experience design, to develop a more comprehensive model of digital inclusion. From a practical perspective, policymakers are encouraged to invest in sustainable, community-based digital literacy programs that are inclusive, context-sensitive, and aligned with broader social equity goals, ensuring that digital transformation initiatives do not exacerbate existing inequalities.

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