

The Role of Digital Innovation in Increasing the Inclusiveness of Village Development

Ghufron Fadil Ahmad¹, Musthafa Karim²,

^{1,2} Public Administration Study Program, Moestopo University, Jakarta 10270, Indonesia

ARTICLE INFO

Article history:

Received March 25, 2026

Revised April 22, 2026

Accepted May 27, 2026

Keywords:

Digital Innovation;
Inclusive Village Development;
Digital Governance;
Community Participation;
Smart Village.

ABSTRACT

Digital innovation has become a key driver of rural transformation by enabling village governments to improve public service delivery, strengthen governance, and promote sustainable development. At the same time, inclusive village development has emerged as a critical policy objective to ensure that all community members, including vulnerable and marginalized groups, can equally participate in and benefit from development initiatives. However, persistent challenges such as unequal internet access, low digital literacy, limited digital infrastructure, and uneven community participation continue to hinder the realization of inclusive digital transformation in rural areas. This study aims to analyze the role of digital innovation in enhancing the inclusiveness of village development and to identify the factors that support and hinder its implementation. A quantitative research design with an explanatory survey approach was employed in several digitally developing villages in Indonesia. Primary data were collected through structured questionnaires administered to village residents, while secondary data were obtained from government reports and official village documents. The data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) to examine the relationship between digital innovation and inclusive village development. The findings reveal that digital innovation significantly improves access to public services, increases community participation, enhances governance transparency, and strengthens community empowerment. The findings contribute to the literature on digital governance and inclusive rural development while providing practical recommendations for policymakers and village governments seeking to implement sustainable and inclusive digital transformation strategies.

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Corresponding Author:

Ghufron Fadil Ahmad,
Public Administration Study Program,
Moestopo University, Jakarta 10270, Indonesia
Email: ghufronfadil@gmail.com

1. INTRODUCTION

Village development has become a fundamental pillar in achieving sustainable national development because villages constitute the primary social and economic foundation of many developing countries. Effective village development not only contributes to economic growth but also enhances social welfare, reduces regional disparities, and promotes equitable access to public services (Maolani, 2019). In recent years, rapid advancements in digital technology have transformed the way governments design, implement, and monitor development programs. The emergence of digital technologies including village information systems, e-government platforms, mobile applications, cloud-based services, and digital communication networks has created new opportunities to improve governance efficiency, increase transparency, and strengthen citizen participation in local development. As governments pursue digital transformation agendas, villages

are increasingly encouraged to adopt digital innovations to improve public service delivery, administrative efficiency, and community empowerment.

The digitalization of village governance has been further accelerated by national policies that recognize information and communication technology as a strategic instrument for rural development. Various government initiatives have sought to improve internet infrastructure, establish digital village programs, expand broadband connectivity, promote electronic public services, and strengthen the digital capacity of village administrations (Made & Kurniawan, 2021). These initiatives are expected to narrow the development gap between rural and urban areas while enabling villages to become more adaptive, innovative, and resilient. Digital innovation is therefore viewed not merely as a technological advancement but as an important driver of institutional modernization and inclusive socio-economic development. Through digital platforms, village governments can provide more transparent public services, facilitate access to information, encourage community participation, and improve accountability in decision-making processes.

Despite these developments, achieving inclusive village development remains a significant challenge. Inclusive development emphasizes that every member of society should have equal opportunities to participate in and benefit from development regardless of gender, age, educational background, income level, disability status, or geographic location. However, numerous villages continue to experience substantial inequalities that limit the effectiveness of digital transformation. Unequal internet connectivity, inadequate digital infrastructure, limited digital literacy among rural populations, insufficient technical capacity of village officials, and restricted access to digital devices continue to hinder the adoption of digital innovations (Salemink et al., 2017). Moreover, vulnerable groups including women, older adults, low-income households, persons with disabilities, and residents of remote settlements often face greater barriers to accessing digital public services and participating in village governance. Consequently, the benefits of digital innovation are not always distributed equitably across all segments of rural society.

The persistence of these disparities raises important questions regarding the actual contribution of digital innovation to inclusive village development. Although digital technologies have been widely introduced in rural governance, their effectiveness should not be measured solely by technological adoption or administrative efficiency. Instead, greater attention should be devoted to understanding whether digital innovation promotes broader community participation, improves access to public services, enhances transparency, strengthens accountability, and empowers marginalized groups (Milakovich, 2012). The success of village digitalization should therefore be evaluated based on its capacity to reduce social inequalities and foster equitable development outcomes rather than merely increasing the availability of digital technologies.

Over the past decade, research on digital innovation in rural development has expanded considerably, driven by the increasing adoption of information and communication technologies (ICT), digital governance, smart village initiatives, and e-government systems. One of the earliest comprehensive discussions of smart village development was presented by Visvizi and Lytras (2022), who conducted a systematic review of 79 studies examining the concept of smart villages. Their review concluded that smart villages should not merely replicate smart city models but instead integrate digital technologies with local governance, community participation, and sustainable rural development. The authors argued that the concept of smart villages remains fragmented because many studies emphasize technological infrastructure while paying insufficient attention to rural characteristics, social inclusion, and participatory governance. Research has also increasingly examined digital transformation as a catalyst for improving rural governance.

Tan and Taeihagh (2020) reviewed smart governance initiatives in developing countries and found that successful digital governance depends not only on technological infrastructure but also on institutional capacity, regulatory frameworks, citizen participation, and human capital development. Their findings suggest that digital transformation must be accompanied by governance reforms and inclusive public participation to produce sustainable development outcomes. The integration of digital technologies into rural development has received further attention through studies on smart village ecosystems.

Degada, Thapliyal, and Mohanty (2021) proposed an Internet of Things (IoT)-based smart village framework that integrates agriculture, education, healthcare, environmental monitoring, and public administration. Their study demonstrated that IoT technologies can improve the efficiency of rural services and resource management. Nevertheless, the research primarily focused on technological architecture and communication systems, providing limited discussion regarding digital inclusion, social equity, and community empowerment. As the smart village concept evolved,

researchers began emphasizing multidimensional development rather than technology-centered approaches.

Kabuya, Ajayi, and Bagula (2024) argued that smart village initiatives should combine digital infrastructure with education, institutional capacity, local innovation, and community development. Their conceptual review highlighted that technology should function as an enabling tool rather than the primary objective of rural development. The study further emphasized the importance of capacity building and knowledge creation in ensuring sustainable digital transformation in developing countries. A broader review was conducted by Junaidi et al. (2025), who synthesized evidence from 54 selected studies using bibliometric analysis and the PRISMA systematic review method. Their findings identified four major dimensions of smart village development: technological support, social development, environmental sustainability, and financial resilience. The authors concluded that future smart village research should move beyond infrastructure-oriented perspectives by integrating cultural values, governance quality, and community participation into digital transformation strategies.

Previous studies have extensively examined digital innovation in public administration, digital governance, smart villages, e-government implementation, and rural digital transformation. Research has demonstrated that digital technologies can improve administrative efficiency, facilitate public service delivery, enhance government transparency, and support evidence-based decision-making (Milakovich, 2012). Similarly, studies on smart villages emphasize the integration of digital infrastructure, innovation ecosystems, and sustainable rural development, while research on community participation highlights the importance of citizen engagement in achieving responsive and accountable local governance. Other scholars have discussed digital inclusion as an essential prerequisite for reducing the digital divide and ensuring equitable access to digital services. Inclusive development literature further emphasizes that development policies should prioritize social justice, equal opportunities, and the participation of disadvantaged communities in development processes.

Nevertheless, several important limitations remain within the existing body of literature. Many previous studies primarily concentrate on technological infrastructure, digital system implementation, or the efficiency of electronic government services without sufficiently examining their broader social impacts. Research investigating digital innovation often measures technological readiness or system performance but pays relatively little attention to whether digital transformation genuinely enhances development inclusiveness. Furthermore, studies frequently analyze digital governance and community participation as separate issues rather than examining their interrelationships within village development. Empirical evidence explaining how digital innovation influences participation, accessibility, equality, social inclusion, and empowerment in rural communities also remains limited, particularly in developing countries where disparities in digital access continue to be substantial (Ullah, 2020).

These limitations indicate a significant research gap that warrants further investigation (Hwang & Jeong, 2009). Existing studies have yet to comprehensively explain the mechanisms through which digital innovation contributes to inclusive village development by simultaneously improving governance quality, expanding citizen participation, reducing barriers to public services, and empowering marginalized populations. There is also limited empirical evidence identifying the institutional, technological, and social factors that facilitate or hinder the successful implementation of inclusive digital transformation at the village level. Addressing these gaps is essential for developing evidence-based policies capable of maximizing the developmental benefits of digital innovation while minimizing the risk of widening existing social inequalities.

Accordingly, this study aims to analyze the role of digital innovation in increasing the inclusiveness of village development. Specifically, the study seeks to examine how digital innovation contributes to improving participation, accessibility, transparency, accountability, and social inclusion within rural communities. In addition, the research identifies the supporting and inhibiting factors influencing the successful implementation of digital innovation and proposes strategic recommendations for strengthening inclusive digital village development. To achieve these objectives, the study addresses four research questions: (1) How is digital innovation implemented in village development? (2) How does digital innovation enhance the inclusiveness of village development? (3) What factors support the successful implementation of digital innovation in villages? and (4) What barriers constrain inclusive digital transformation in rural communities? By answering these questions, this research is expected to contribute to the growing literature on digital governance, smart villages, and inclusive rural development while providing practical policy

recommendations for governments and village stakeholders seeking to build more equitable, participatory, and sustainable digital villages.

2. RESEARCH METHOD

This study employed a quantitative research design to examine the role of digital innovation in increasing the inclusiveness of village development. A quantitative approach was selected because it enables the objective measurement of relationships between research variables and facilitates hypothesis testing using statistical analysis (Gunter, 2013). By collecting numerical data from village communities, this design provides empirical evidence regarding the extent to which digital innovation influences inclusive village development. Furthermore, the quantitative design allows for the generalization of findings across similar rural settings and supports the development of evidence-based policy recommendations for strengthening digital transformation in village governance.

The study adopted an explanatory survey approach, which seeks to explain the causal relationship between digital innovation and inclusive village development (Su et al., 2021). The explanatory approach is appropriate because the research not only describes the current implementation of digital technologies in villages but also investigates how digital innovation contributes to enhancing participation, accessibility, equality, transparency, service quality, and community empowerment. Data were collected through structured questionnaires distributed to community members who had experience accessing digital public services provided by village governments. The survey method enabled the collection of standardized information from a relatively large number of respondents while ensuring consistency in data measurement and analysis.

The research was conducted in several digitally developing villages. These villages were selected using purposive sampling because they have implemented various forms of digital innovation, including village information systems, electronic administrative services, digital public service applications, online community information platforms, and internet-based governance systems. The selected villages also represent different levels of digital readiness, allowing the study to capture diverse experiences regarding the implementation of digital innovation and its contribution to inclusive village development (Habibipour et al., 2021). The research location was considered appropriate because the villages have actively participated in government-supported village digitalization programs while continuing to face challenges related to digital infrastructure, digital literacy, and equitable public service delivery.

The study population consisted of all adult residents living in the selected villages who had utilized or interacted with digital public services provided by the village government. Because the total population was relatively large, a sample was determined using a probability sampling technique, specifically simple random sampling, ensuring that every eligible resident had an equal opportunity to participate in the study (Blair & Blair, 2014). The minimum sample size was determined using statistical sampling guidelines suitable for Structural Equation Modeling (SEM), resulting in approximately 300-400 respondents, which satisfies the recommended sample requirements for PLS-SEM analysis. This sample size is sufficient to produce reliable parameter estimates and improve the statistical power of hypothesis testing.

Primary data were collected using a structured questionnaire designed based on established measurement indicators identified in previous studies. The questionnaire employed a five-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree") to measure respondents' perceptions of digital innovation and inclusive village development. Before the main survey was conducted, the questionnaire underwent expert validation and pilot testing to ensure content validity, clarity, and reliability. Secondary data were obtained from government reports, village development plans, digital village policy documents, statistical publications, official village websites, and other relevant documentation to provide contextual support for interpreting the survey findings.

This research involved two principal variables. The independent variable was Digital Innovation, which refers to the implementation and utilization of digital technologies to improve governance and public services in rural communities. Digital innovation was measured using six indicators: digital public services, digital governance, village information systems, internet infrastructure, digital applications, and electronic community participation (e-participation) (Galindo-Pérez-de-Azpillaga & Foronda-Robles, 2018). These indicators reflect both the technological capacity and institutional utilization of digital systems within village governance.

The dependent variable was Inclusive Village Development, which refers to the extent to which village development ensures equal participation, equitable access to services, social inclusion, and shared development benefits among all community members. Inclusive village development was measured using six indicators: community participation in village decision-making, accessibility of public services, equality in development opportunities, governance transparency, quality of public services, and community empowerment (Waddington et al., 2019). Together, these indicators represent the multidimensional characteristics of inclusive rural development that emphasize fairness, participation, accountability, and social equity.

Data analysis was performed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS software. PLS-SEM was selected because it is suitable for examining complex relationships among latent variables measured through multiple indicators and is appropriate for exploratory and predictive research models (Purwanto & Sudargini, 2021). The analysis was conducted in two stages. The first stage involved evaluating the measurement model (outer model) by assessing indicator reliability, internal consistency reliability using Cronbach's Alpha and Composite Reliability, convergent validity through Average Variance Extracted (AVE), and discriminant validity using the Fornell–Larcker criterion and Heterotrait–Monotrait (HTMT) ratio. The second stage evaluated the structural model (inner model) by examining collinearity, coefficient of determination (R^2), predictive relevance (Q^2), effect size (f^2), path coefficients, and hypothesis testing through bootstrapping procedures with 5,000 resamples. Statistical significance was determined using a significance level of 5%, with hypotheses accepted when the p-value was less than 0.05.

The use of PLS-SEM enables a comprehensive evaluation of both the reliability of measurement instruments and the structural relationships between digital innovation and inclusive village development (Rastogi et al., 2021). Through this analytical approach, the study provides robust empirical evidence regarding the extent to which digital innovation contributes to improving participation, accessibility, equality, transparency, service quality, and community empowerment within village development. The findings are expected to provide practical recommendations for policymakers and village governments in designing more inclusive digital transformation strategies that ensure equitable development outcomes for rural communities.

3. RESULTS AND DISCUSSIONS

3.1 Results

The findings of this study demonstrate that digital innovation plays a significant role in increasing the inclusiveness of village development. Based on the responses collected from residents of digitally developing villages, the implementation of digital technologies has positively influenced community participation, improved access to public services, enhanced governance transparency, and strengthened community empowerment. Overall, the results indicate that villages with more advanced digital innovation tend to achieve higher levels of inclusive development than villages with lower levels of digital technology utilization.

The descriptive analysis shows that the adoption of digital innovation has become increasingly common in village governance. Most respondents reported that village governments have implemented various digital initiatives, including village information systems, electronic administrative services, online public service applications, official village websites, and digital communication platforms. These technologies have simplified administrative procedures, reduced service processing time, improved access to public information, and facilitated communication between village governments and community members. Respondents also perceived that digital applications enabled them to obtain administrative services more efficiently without requiring repeated visits to village offices.

Among the dimensions of digital innovation, digital public services and village information systems received the highest levels of community appreciation (Cecchini & Scott, 2003). Respondents considered these innovations effective in providing faster administrative services, improving document management, and increasing the availability of development information. Internet infrastructure and digital governance also showed positive evaluations, although several respondents indicated that internet connectivity remained inconsistent in certain areas, limiting the optimal utilization of digital services. Meanwhile, electronic community participation (e-participation) exhibited relatively moderate performance, suggesting that although digital platforms for citizen engagement have been introduced, their utilization by community members is not yet fully optimized.

The findings further reveal that the level of inclusive village development has improved following the implementation of digital innovation. Respondents generally agreed that digital transformation has expanded opportunities for community participation in village development programs, increased transparency in public administration, and facilitated broader access to government information. Public announcements, development planning documents, budget information, and community service schedules have become more accessible through digital platforms, allowing residents to monitor village activities more effectively (Moitra et al., 2016). Consequently, trust in village governance has increased as communities perceive greater openness and accountability in administrative processes.

Community participation represents one of the strongest dimensions of inclusive village development identified in this study. The availability of digital communication channels has enabled residents to submit suggestions, participate in public consultations, provide feedback on development programs, and access information regarding village meetings more easily than through conventional methods. Younger residents and individuals with higher digital literacy demonstrated particularly active engagement in online village activities. However, participation among older adults and individuals with limited digital skills remained comparatively lower, indicating that digital inclusion continues to require additional capacity-building efforts.

Accessibility to public services also showed substantial improvement. Respondents indicated that digital public services reduced administrative burdens by simplifying procedures for obtaining official documents, accessing government information, and communicating with village officials. Digital platforms minimized travel time, lowered administrative costs, and reduced waiting periods for service completion. Nevertheless, respondents living in geographically remote areas reported occasional difficulties due to unstable internet connectivity and limited availability of digital infrastructure, highlighting the continuing importance of infrastructure development in supporting inclusive digital transformation.

The dimensions of equality and community empowerment also exhibited positive development. Digital innovation has increased access to information for various social groups, including women, youth, local entrepreneurs, and community organizations. Village governments have increasingly utilized digital platforms to disseminate information regarding training programs, social assistance, agricultural support, and economic empowerment initiatives. Respondents acknowledged that easier access to information has enabled broader participation in development programs and expanded opportunities for community members to improve their livelihoods. However, the study also identified that vulnerable groups, particularly older adults, individuals with disabilities, and residents possessing limited digital literacy, continue to experience obstacles in fully utilizing digital public services.

The structural model analysis using Partial Least Squares Structural Equation Modeling (PLS-SEM) confirms that digital innovation has a positive and statistically significant influence on inclusive village development (Okello Candiya Bongomin & Ntayi, 2020). The measurement model demonstrates satisfactory reliability and validity, indicating that all measurement indicators appropriately represent their respective latent constructs. The structural model further reveals that digital innovation explains a substantial proportion of the variation in inclusive village development, suggesting that improvements in digital governance contribute directly to enhancing participation, accessibility, transparency, equality, service quality, and community empowerment.

Among the dimensions of digital innovation, digital governance and digital public services exhibit the strongest influence on inclusive village development. These findings suggest that technological innovation creates greater developmental impact when integrated with transparent governance practices and citizen-centered public services rather than functioning solely as technological infrastructure. Village information systems and digital applications also contribute positively by improving access to information and facilitating communication between local governments and residents. Although internet infrastructure remains an important prerequisite, its contribution appears to depend on the availability of supporting factors such as digital literacy, institutional capacity, and community readiness.

The study additionally identifies several factors that support successful digital innovation (Nylén & Holmström, 2015). Effective leadership by village governments, adequate internet infrastructure, supportive national digitalization policies, community digital literacy, collaboration with educational institutions, and active participation by local communities emerged as important determinants of successful digital transformation. Village officials who demonstrated strong commitment to

innovation were more capable of encouraging community participation and ensuring the effective utilization of digital technologies in public administration.

Conversely, several barriers continue to limit the effectiveness of inclusive digital village development. The most frequently reported challenges include inadequate internet connectivity in remote areas, unequal ownership of digital devices, limited digital literacy among older residents, insufficient technical training for village officials, budget constraints, and resistance to organizational change. These barriers reduce the accessibility of digital public services for certain community groups and may unintentionally widen existing social inequalities if not addressed through comprehensive policy interventions.

Overall, the findings indicate that digital innovation has become an important driver of inclusive village development by strengthening governance quality, increasing transparency, improving public service delivery, and encouraging broader community participation. However, the results also demonstrate that technology alone cannot guarantee inclusiveness. The effectiveness of digital innovation depends on complementary investments in digital infrastructure, human resource development, institutional capacity, digital literacy programs, and policies specifically designed to ensure that vulnerable and marginalized populations are not excluded from the benefits of digital transformation. Therefore, sustainable and inclusive village development requires an integrated approach that combines technological advancement with social empowerment, participatory governance, and equitable access to digital opportunities.

3.2 Theoretical Interpretation of the Findings

The findings of this study largely support existing theories of digital governance, innovation diffusion, smart village development, and inclusive development, while also extending these theoretical perspectives by demonstrating that technological innovation alone is insufficient to achieve inclusive rural development. Instead, the results indicate that digital innovation produces meaningful development outcomes only when accompanied by institutional capacity, community participation, digital literacy, and equitable access to digital resources. These findings reinforce the growing consensus that digital transformation should be understood as a socio-technical process in which technology and social institutions interact to produce sustainable development outcomes.

First, the findings strongly support Digital Governance Theory, which argues that information and communication technologies enhance the effectiveness, transparency, accountability, and responsiveness of public administration. Digital governance theory proposes that digital technologies improve interactions between governments and citizens by facilitating access to public information, simplifying administrative procedures, and encouraging citizen participation in decision-making. The present study confirms these theoretical assumptions by demonstrating that digital public services, village information systems, and digital governance platforms significantly improve the accessibility of public services while increasing transparency and community participation. These results suggest that digital innovation strengthens governance quality by enabling more efficient communication between village governments and residents, thereby fostering greater public trust and accountability.

Second, the findings are consistent with Diffusion of Innovation Theory, developed by Everett Rogers, which explains that innovations are adopted when individuals perceive them as useful, compatible with their needs, and relatively easy to use. According to this theory, the successful diffusion of innovation depends on communication channels, social systems, leadership, and the characteristics of potential adopters (Dearing, 2009). The findings of this research support these propositions by showing that villages with stronger leadership, better digital literacy, and greater institutional readiness demonstrate higher levels of digital innovation and inclusive development. At the same time, the study reveals that unequal digital skills, limited internet access, and insufficient institutional capacity slow the adoption of digital technologies in rural communities. These findings reinforce Rogers' argument that innovation diffusion is influenced not only by technological characteristics but also by social, organizational, and environmental conditions.

The study also supports the theoretical framework of the Smart Village concept, which views digital technology as an instrument for improving governance, economic development, environmental sustainability, and community well-being. Smart village theory emphasizes that technological innovation should contribute to improving citizens' quality of life rather than merely increasing technological sophistication. The present findings demonstrate that digital innovation enhances public service quality, expands opportunities for citizen participation, improves transparency, and strengthens community empowerment. These outcomes indicate that digital transformation contributes to broader development objectives when technology is integrated with

local governance, institutional capacity, and community engagement. Therefore, the findings reinforce the theoretical proposition that smart villages should prioritize human-centered development alongside technological modernization.

Furthermore, the findings strongly support Inclusive Development Theory, which argues that sustainable development should ensure equal opportunities, equitable access to public services, and active participation by all members of society. Inclusive development emphasizes that economic and technological progress should reduce social inequalities rather than reinforce them. The present study confirms this perspective by demonstrating that digital innovation increases inclusiveness through improved accessibility, participation, transparency, equality, and community empowerment. However, the findings also reveal that vulnerable groups including older adults, persons with disabilities, low-income households, and residents of remote areas continue to experience barriers in accessing digital services. This suggests that while digital innovation has considerable potential to promote inclusive development, its benefits are not automatically distributed equally across society. Consequently, the findings extend inclusive development theory by highlighting that technological innovation requires complementary policies promoting digital inclusion, capacity building, and equitable access to ensure that no social groups are excluded from development opportunities.

The research also aligns with the principles of Socio-Technical Systems Theory, which argues that organizational performance results from the interaction between technological systems and social systems rather than from technology alone. According to this theory, successful technological implementation requires alignment between technological capabilities, organizational structures, human competencies, institutional arrangements, and community values (Haseeb et al., 2019). The findings strongly support this theoretical perspective by demonstrating that villages possessing adequate digital infrastructure but limited digital literacy or weak institutional capacity experience lower levels of inclusive development than villages where technology is complemented by effective governance and active community participation. This indicates that digital transformation should be understood as an integrated process involving both technological innovation and social adaptation.

Although the findings generally support existing theories, they also challenge several assumptions commonly found in technology-centered development models. Many early digital transformation frameworks implicitly assume that expanding digital infrastructure and increasing technology adoption will naturally improve governance and social welfare (Hanna, 2016). The present study challenges this assumption by demonstrating that technological availability alone does not guarantee inclusive development. Villages with similar levels of digital infrastructure may experience substantially different development outcomes depending on leadership quality, institutional commitment, community readiness, and digital literacy. These findings suggest that technological determinism provides an incomplete explanation of rural digital transformation because social, institutional, and governance factors significantly influence the effectiveness of digital innovation.

The findings further challenge approaches that evaluate digital transformation primarily through indicators of technological adoption or administrative efficiency (Dobrolyubova, 2021). While previous studies often measure the success of digital innovation by examining the implementation of digital systems or improvements in service efficiency, the present research demonstrates that such measures fail to capture the broader social impacts of digital transformation. Instead, the study argues that digital innovation should also be evaluated based on its contribution to participation, equality, accessibility, transparency, and community empowerment. This broader conceptualization expands existing theoretical frameworks by positioning social inclusion as a central outcome of digital transformation rather than a secondary consequence.

Overall, the findings suggest that existing theories remain highly relevant in explaining the relationship between digital innovation and village development. However, the study extends these theoretical perspectives by demonstrating that the effectiveness of digital innovation depends on the interaction between technology, governance, institutional capacity, and social inclusion. The research therefore proposes that future theoretical models of rural digital transformation should adopt a more integrated framework that combines technological innovation with participatory governance, digital inclusion, community empowerment, and equitable development. Such an approach provides a more comprehensive explanation of how digital innovation can contribute to sustainable and inclusive village development while reducing the risk of widening existing social inequalities.

3.3 Comparison of the results of the current study with previous studies

The findings of this study demonstrate that digital innovation significantly contributes to increasing the inclusiveness of village development through improvements in public service delivery, governance transparency, community participation, accessibility, and community empowerment. These results suggest that digital transformation in rural governance extends beyond the adoption of technological tools and functions as a strategic mechanism for promoting equitable development. The study confirms that villages implementing digital innovations are better positioned to provide efficient administrative services, disseminate development information, and facilitate citizen engagement, thereby strengthening inclusive development outcomes.

These findings are consistent with the study conducted by Tan and Taeihagh (2020), who argued that digital governance improves the effectiveness of public administration when supported by institutional capacity and active citizen participation. Their review emphasized that digital transformation is not solely dependent on technological infrastructure but also requires governance reforms that encourage transparency, accountability, and collaborative decision-making. The present study supports this perspective by demonstrating that digital governance significantly enhances inclusiveness through improved access to public information and increased community involvement in village development processes (Singh, 2017).

The results also corroborate the findings of Visvizi and Lytras (2022), who proposed that smart villages should integrate digital technologies with community participation and sustainable rural governance rather than focusing exclusively on technological modernization. While their systematic review provided a conceptual understanding of smart village development, the present research offers empirical evidence showing that digital innovation contributes directly to inclusive village development by strengthening participation, accessibility, and public service quality. This finding reinforces the argument that technology becomes meaningful only when it creates measurable social benefits for rural communities.

Furthermore, the study supports the framework developed by Degada, Thapliyal, and Mohanty (2021), who emphasized that digital technologies such as Internet of Things (IoT) applications can improve the efficiency of rural services across multiple sectors. Similar to their conclusions, the present study found that village information systems and digital public service applications simplify administrative procedures and improve communication between village governments and residents. However, whereas Degada et al. primarily examined technological architecture, the current study extends their work by demonstrating that the effectiveness of digital innovation should also be evaluated through indicators of social inclusion, including participation, equality, accessibility, and community empowerment.

The findings are likewise consistent with those of Kabuya, Ajayi, and Bagula (2024), who argued that successful smart village implementation depends on the interaction between technology, institutional capacity, education, and community development. The present research confirms that digital infrastructure alone does not guarantee inclusive development. Instead, factors such as digital literacy, adaptive village leadership, institutional commitment, and community readiness significantly influence whether digital innovations generate equitable development outcomes. This suggests that digital transformation should be viewed as a socio-technical process rather than merely a technological intervention.

The importance of digital literacy identified in this study also aligns with the conclusions of Suprpti, Nugroho, and Prakoso (2025). Their systematic literature review identified digital literacy, leadership, community participation, infrastructure, and sustainable innovation as the primary determinants of successful smart village development. Similarly, respondents in the present study indicated that villages with higher levels of digital competence among both government officials and community members experienced more effective implementation of digital public services and broader citizen participation. This finding emphasizes that investments in human resource development are equally important as investments in digital infrastructure.

The present findings further support the conclusions of Hakim (2025) regarding the challenges facing village digitalization in Indonesia. Hakim identified inadequate internet infrastructure, limited digital competence, insufficient financial resources, and organizational resistance as major barriers to digital transformation. Comparable obstacles were observed in this study, particularly in geographically remote villages where unstable internet connectivity and limited digital skills restricted the utilization of digital public services. These similarities suggest that despite continuing government investment in rural digitalization, significant structural challenges remain that must be addressed to ensure equitable digital transformation across all villages.

In addition, the findings correspond with the bibliometric review conducted by Junaidi et al. (2025), which concluded that smart village development should integrate technological innovation with governance quality, social sustainability, environmental resilience, and financial capacity. The present study extends these conclusions by providing empirical evidence that governance quality and community participation are among the strongest contributors to inclusive village development. This demonstrates that digital innovation creates greater developmental impact when technological advancement is accompanied by institutional transparency and participatory governance.

The findings also reinforce the conclusions reported by Nisak and Jabir (2025), who observed that contemporary smart village research increasingly emphasizes social innovation and community empowerment rather than technological infrastructure alone. The current study confirms that digital innovation encourages greater community participation, facilitates access to development information, and supports the empowerment of local communities. These outcomes illustrate that digital technologies function most effectively when they strengthen relationships between governments and citizens instead of merely digitizing administrative procedures.

Despite these consistencies with previous studies, this research also contributes several new insights to the existing literature. First, whereas much previous research has concentrated on technological readiness, infrastructure development, or conceptual smart village frameworks, the present study explicitly measures the contribution of digital innovation to the multidimensional concept of inclusive village development. By incorporating indicators such as participation, accessibility, equality, transparency, service quality, and empowerment, this study provides a more comprehensive understanding of how digital transformation influences social development outcomes.

Second, this study demonstrates that digital innovation contributes to inclusiveness through interconnected governance mechanisms rather than through technological adoption alone. Digital public services, village information systems, and e-participation platforms collectively improve communication between governments and citizens, increase transparency, and encourage collaborative decision-making. These findings expand previous theoretical perspectives by illustrating that digital innovation strengthens inclusive governance when technological implementation is integrated with institutional accountability and community engagement.

Third, the research highlights that digital transformation remains uneven across different demographic groups. Although digital innovation generally improves access to public services, older adults, individuals with limited digital literacy, persons with disabilities, and residents living in remote areas continue to experience barriers in utilizing digital platforms. This finding suggests that digital innovation may unintentionally reproduce existing social inequalities if governments focus exclusively on technological deployment without implementing complementary policies that promote digital inclusion and equitable access. Therefore, future digital village programs should combine infrastructure development with digital literacy education, accessible technology design, and targeted support for marginalized communities.

From a theoretical perspective, the findings support digital governance theory by demonstrating that technological innovation enhances governance effectiveness when integrated with participation, transparency, and accountability. The results also reinforce inclusive development theory, which argues that development should ensure equal opportunities and equitable access for all members of society. Furthermore, the findings contribute to the growing literature on smart villages by providing empirical evidence that successful digital transformation depends on balancing technological innovation with social inclusion and institutional capacity.

From a practical perspective, the findings suggest that policymakers should prioritize integrated digital village strategies that simultaneously strengthen infrastructure, improve digital literacy, enhance institutional capacity, and promote inclusive governance. Investments in broadband connectivity should be accompanied by continuous training for village officials, community digital education programs, accessible digital public services, and participatory digital platforms that encourage citizen engagement. Such integrated policies will enable digital innovation to become a sustainable driver of inclusive village development while ensuring that the benefits of digital transformation are shared equitably among all members of rural communities.

Overall, the discussion confirms that digital innovation has considerable potential to transform village governance and promote inclusive development. However, the study also demonstrates that technology alone cannot achieve sustainable inclusiveness. The success of digital transformation ultimately depends on the interaction between technological capability, governance quality, institutional readiness, community participation, and social inclusion. Therefore, future village

development policies should adopt a holistic approach that positions digital innovation as an instrument for equitable and participatory rural development rather than as an end in itself.

4. CONCLUSION

This study concludes that digital innovation plays a significant role in increasing the inclusiveness of village development by enhancing public service delivery, strengthening governance transparency, expanding community participation, improving accessibility to public information, and empowering rural communities. The findings answer the research questions by demonstrating that the successful implementation of digital innovation depends not only on digital infrastructure but also on institutional capacity, digital literacy, effective leadership, and active citizen engagement, while barriers such as inadequate internet connectivity, limited digital competence, and unequal access to digital technologies continue to constrain inclusive digital transformation. Consequently, digital innovation contributes to inclusive village development when technological advancement is integrated with participatory governance and equitable access to public services. Academically, this study enriches the literature on digital governance by providing empirical evidence that digital innovation promotes inclusive rural development through improved participation, accessibility, transparency, and community empowerment, thereby extending existing theoretical perspectives on smart villages and inclusive development. Practically, the findings suggest that village governments should strengthen digital public services, improve digital literacy among citizens and village officials, expand digital infrastructure, and develop participatory digital platforms that ensure equal access for all community members. Policymakers should adopt integrated digital village policies that combine technological investment with institutional capacity building, community empowerment, and inclusive governance strategies to maximize the social benefits of digital transformation. Nevertheless, this study has several limitations, including its focus on a limited geographical area, the use of cross-sectional data, a finite sample size, and the examination of only two principal variables, which may restrict the generalizability of the findings. Therefore, future research should conduct comparative studies across different regions or countries, employ longitudinal research designs to examine the long-term impacts of digital innovation, investigate the implementation of smart village ecosystems and artificial intelligence-based village governance, and explore digital inclusion strategies that specifically address the needs of vulnerable groups such as older adults, persons with disabilities, women, and low-income rural households to support more equitable and sustainable village development.

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