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Research Article

Empowering Local Governance through Data-Driven Capacity Building: Assessing Computer Literacy and Data Utilization

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ABSTRACT

In the era of digitalization and data-driven governance, local government units (LGUs) face growing pressure to enhance their computer literacy and data utilization skills. This study provides a focused assessment of these critical competencies within Antique Province, Philippines, an agricultural region striving to bridge the digital divide, the gap between those with access to modern information technologies and those without. Using a mixed-methods approach, which includes surveys, interviews, focus group discussions, and secondary data analysis, the research evaluates the digital capabilities and data-driven governance practices among LGUs. The findings reveal notable disparities in computer literacy and data usage, with some LGUs making progress in digital transformation while others face challenges such as infrastructure limitations, resource constraints, and skills gaps. This study also identifies innovative strategies and best practices from successful LGUs that could serve as models for others. The research proposes specific recommendations to address these gaps, such as establishing training programs, investing in digital infrastructure, and fostering strategic partnerships. Additionally, it emphasizes the need for change management, a data governance policy framework, and a culture of continuous learning to ensure sustainable progress. By addressing these barriers, this study aims to empower Antique Province LGUs, enhancing decision-making, resource allocation, and overall service delivery through data-driven capacity building.

Keywords*: Local governance, Data-driven decision making, Computer literacy, Data utilization, Capacity building, Digital transformation, E-governance, Skills development*

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Introduction

The rapid digitalization of government operations and the growing emphasis on data-driven decision-making have reshaped the skills and tools required for effective governance (Chen, L., Wang, M., & Liu, X., 2023). In the context of decentralized governance, local government units (LGUs) in the Philippines have been given the responsibility to spearhead regional development efforts. However, this shift brings with it the need for LGUs to effectively harness digital tools and data analytics to improve service delivery and enable informed decision-making (Villanueva et al., 2023).

In rural regions like Antique Province—an agricultural area in Western Visayas—these challenges become particularly pronounced. Despite national initiatives aimed at fostering digital transformation, many rural LGUs face significant obstacles, including inadequate digital infrastructure, insufficient access to resources, and low levels of digital literacy (Perez & Santos, 2022; Martinez, R. A., Garcia, S. P., & Dela Cruz, J. M., 2022). While some urbanized LGUs have begun to integrate digital technologies into their governance models, rural areas lag behind, exacerbating the digital divide—the gap between those who have access to digital technologies and those who do not (Reyes et al., 2022).

Current research has predominantly focused on digital governance in urban centers and more developed regions. Although several studies highlight the importance of e-governance in improving service delivery and promoting transparency (Tang & Ho, 2022; Kumar, A., Singh, P., & Sharma, N., 2024), there is limited research that specifically examines the unique digital challenges faced by rural LGUs, particularly in agricultural regions like Antique. Moreover, while research exists on e-governance and digital transformation in developing countries, the intersection of digital governance and agricultural development remains underexplored (Ramos & Fernandez, 2023; Thompson, K. E., Anderson, M. J., & Rodriguez, C. A., 2023).

The need for more targeted research on how rural LGUs can improve their digital literacy and effectively utilize data-driven practices is essential. This study seeks to address these gaps by exploring how LGUs in Antique Province can enhance their governance through digital tools and data analytics, focusing on the barriers and opportunities unique to rural, agriculture-focused regions (Williams, D. R., Johnson, L. K., & Brown, A. S., 2024). While this study focuses on Antique Province in the Philippines, its findings have broader implications for digital governance in rural agricultural regions globally. Many developing countries face similar challenges in bridging the digital divide between urban and rural areas, particularly in regions where agriculture remains the economic backbone. The insights from this study can inform digital transformation strategies in comparable contexts across Southeast Asia, Africa, and Latin America, where local governments navigate similar constraints of limited resources, infrastructure challenges, and varying levels of digital literacy. Furthermore, as the global community increasingly emphasizes sustainable development goals related to reducing inequalities and building resilient institutions, understanding effective pathways to digital inclusion in underserved regions becomes relevant beyond national boundaries. This research contributes to the growing body of knowledge on context-specific approaches to digital governance that address the unique needs of rural agricultural communities.

Statement of the Problem

Despite the national push toward digital governance, many rural LGUs, including those in Antique Province, face considerable challenges in adopting digital technologies. These challenges are compounded by the region's agricultural economy, dispersed geographic landscape, and varying levels of digital literacy among LGU personnel. As a result, LGUs struggle to fully leverage digital tools and data-driven practices for effective governance. The primary research question guiding this study is: How can rural LGUs in Antique Province overcome barriers to digital transformation and leverage data-driven practices to improve governance? To address this question, the study aims to:

1. Assess digital literacy levels and data utilization practices among local government personnel;

2. Identify key barriers to digital transformation in rural agricultural contexts;
3. Evaluate current digital infrastructure and its impact on governance effectiveness; and
4. Develop evidence-based recommendations for enhancing data-driven governance capabilities.

This research aims to provide valuable insights into the digital transformation challenges faced by rural LGUs, particularly in regions like Antique that are heavily reliant on agriculture. By focusing on digital literacy, data utilization, and infrastructure barriers, this study seeks to inform capacity-building initiatives and policy reforms that can enable LGUs to harness the power of digital tools for improved governance. Moreover, the research will contribute to filling the gap in the literature regarding the intersection of digital governance and rural development, offering evidence-based solutions tailored to the needs of agricultural regions.

Capacity-Building Framework

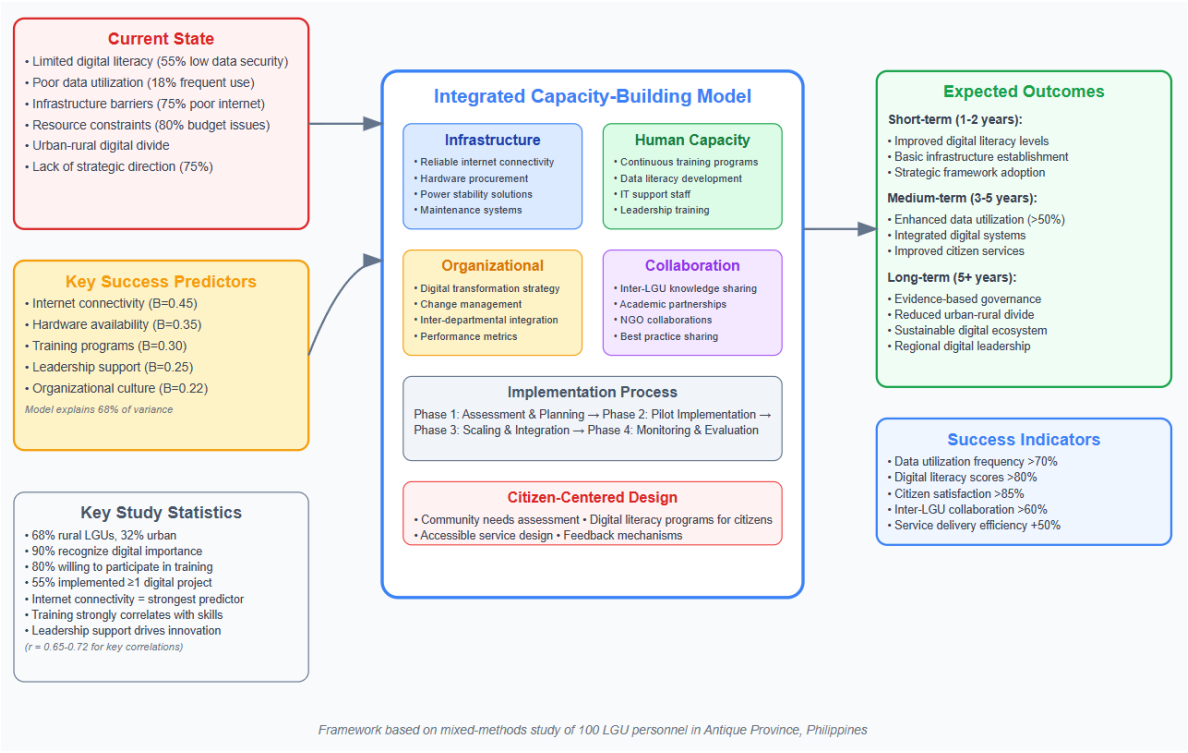

Figure 1. Digital Governance Capacity-Building Framework for Rural LGUs

This comprehensive framework presents a strategic approach to addressing digital capacity challenges in Philippine Local Government Units (LGUs), based on empirical research from Antique Province involving 100 LGU personnel.

The study reveals significant digital capacity gaps across Philippine LGUs. With 68% of surveyed units being rural and 32% urban, the research highlights critical challenges including limited digital literacy (55% experiencing low data security), poor data utilization (only 16% frequent use), and substantial infrastructure barriers (75% facing poor internet connectivity). Perhaps most concerning is the lack of strategic direction, affecting 75% of LGUs, alongside persistent urban-rural digital divides.

The framework identifies five key predictors of digital transformation success, with internet connectivity emerging as the strongest factor (ß=0.45). Hardware availability (ß=0.35) and training programs (ß=0.30) follow as critical elements, while leadership support (ß=0.25) and organizational culture (ß=0.22) provide essential foundational elements. Together, these factors explain 68% of

the variance in successful digital implementation.

The proposed model addresses four interconnected dimensions. Infrastructure development focuses on reliable internet connectivity, hardware procurement, power stability, and maintenance systems. Human capacity building emphasizes continuous training programs, data literacy development, IT support staffing, and leadership training. Organizational transformation involves developing digital strategies, managing change processes, ensuring inter-departmental integration, and establishing performance metrics. Collaboration components include inter-LGU knowledge sharing, academic partnerships, NGO collaborations, and best practice dissemination.

The framework employs a four-phase implementation process moving from assessment and planning through pilot implementation, scaling and integration, to monitoring and evaluation. Central to this approach is citizen-centered design, incorporating community needs assessment, digital literacy programs for citizens, accessible service design, and robust feedback mechanisms.

Short-term outcomes (1-2 years) target improved digital literacy levels, basic infrastructure establishment, and strategic framework adoption. Medium-term goals (3-5 years) focus on enhanced data utilization (>50%), integrated digital systems, and improved citizen services. Long-term objectives (5+ years) envision evidence-based governance, reduced urban-rural divides, sustainable digital ecosystems, and regional digital leadership.

The framework establishes clear success indicators including data utilization frequency >70%, digital literacy scores >80%, citizen satisfaction >85%, inter-LGU collaboration >60%, and service delivery efficiency improvements of +50%.

This evidence-based framework provides Philippine LGUs with a structured pathway toward digital transformation, emphasizing the critical importance of integrated capacity building that addresses infrastructure, human resources, organizational culture, and collaborative networks simultaneously. The strong correlation between internet connectivity and success (r=0.65-0.72) underscores the fundamental importance of digital infrastructure as the foundation for broader transformation initiatives.

Scope and Limitations

This study focuses on assessing the digital literacy, data utilization practices, and barriers to digital governance among Local Government Units (LGUs) in Antique Province, Philippines. Specifically, it evaluates the proficiency of LGU personnel in using digital tools relevant to governance, examines how data is utilized for decision-making in key sectors such as agriculture, and identifies the infrastructure, resource, and skill gaps hindering the adoption of digital technologies. The study also explores best practices from other regions or countries to propose capacity-building strategies tailored to the needs of LGUs in rural and agricultural settings.

The research includes LGU personnel from both rural and urban municipalities of Antique, with data gathered through surveys, interviews, and analysis of available digital infrastructures within these LGUs. It applies quantitative methods, including Chi-Square, ANOVA, correlation, and regression analysis, to uncover significant relationships and predictors of digital literacy and data utilization. While this study provides valuable insights into the digital transformation challenges in Antique Province, it is subject to several limitations. First, the study is geographically limited to Antique Province, which may affect the generalizability of the findings to other regions with different socio-economic and cultural contexts. Second, the data collection relies on self-reported surveys and interviews, which may introduce response bias or inaccuracies in reporting digital proficiency and practices. Additionally, the study focuses on LGU personnel, and therefore, the perspectives of other key stakeholders, such as the general public or external service providers, are not directly addressed. Lastly, due to time and resource constraints, the study does not include a longitudinal analysis to track changes in digital literacy and data utilization over time. These limitations highlight the need for further research in similar rural contexts, with broader geographic coverage and more comprehensive data collection methodologies

to strengthen the findings and recommendations.

Review of Related Literature

Digital Governance and Capacity Building in LGUs. Local government units (LGUs) play a critical role in the delivery of services, policy implementation, and fostering local development. In recent years, digital governance has emerged as a powerful tool for enhancing the efficiency and transparency of LGUs. According to Ospina et al. (2020), the adoption of digital technologies within governance systems significantly improves the responsiveness of local governments by streamlining processes and enabling better access to information. However, the digital divide—a term referring to the gap between those who have access to digital technologies and those who do not—remains a significant challenge, particularly in rural and underdeveloped regions (van Deursen & Helsper, 2020). LGUs in the Philippines face diverse challenges related to infrastructure, skills, and policy in their pursuit of digital transformation. Villanueva et al. (2021) identified that digital governance initiatives in rural regions are often hampered by inadequate digital infrastructure and limited access to information and communication technology (ICT) training. These factors create barriers that inhibit the effective utilization of digital tools for decision-making, a crucial aspect for LGUs to function effectively. Similarly, the study by Aceron (2022) emphasized the importance of strategic capacity-building initiatives tailored to the unique needs of rural LGUs, especially those with limited technological resources. Hong et al. (2022) provide a critical theoretical framework for understanding digital disparities in governance, arguing that these disparities stem not only from technological access but also from socio-cultural factors, institutional arrangements, and power dynamics within organizations. Their work suggests that addressing the digital divide requires a multi-dimensional approach that considers these broader contextual factors. This theoretical perspective helps explain why some LGUs lag behind others in digital adoption despite similar resource constraints.

The Role of Computer Literacy in Public Administration. Computer literacy among LGU personnel is a foundational aspect of digital transformation efforts. Research by Tang and Ho (2022) suggests that the successful implementation of e-governance initiatives heavily relies on the digital skills of personnel involved. In regions where computer literacy is low, public administration remains inefficient and outdated, limiting the ability to leverage data-driven insights for policy development and service delivery. Moreover, recent studies underscore the importance of continuous training and development programs. According to Gunawan and Husin (2023), structured ICT training programs significantly improve computer literacy and empower local government personnel to utilize modern tools for data management and service delivery. This highlights the need for capacity-building efforts that focus on the development of digital skills, which are crucial for achieving long-term governance objectives. A critical perspective offered by Wihlborg and Engström (2023) challenges the assumption that technology adoption alone leads to improved governance. They argue that effective digital transformation requires organizational change management and a culture that values data-driven decision-making. Their research suggests that the success of digital literacy programs depends not just on the technical content but on how well they address organizational culture and change resistance.

Evolving Digital Governance: From E-Government to AI Applications. The digital transformation of local governance has evolved significantly in recent years, moving beyond basic e-government services to more sophisticated applications of artificial intelligence (AI). While earlier e-governance initiatives focused primarily on digitizing existing processes and enhancing accessibility, contemporary approaches increasingly leverage AI to transform service delivery and decision-making. Yigitcanlar et al. (2023) examined public perceptions of AI in local government services in Australia and Hong Kong, finding that citizens generally support AI applications that enhance efficiency and personalization of services, though concerns about privacy and algorithmic bias remain.

Senadheera et al. (2022) provided a comprehensive framework for understanding chatbot adoption in local governments, highlighting how these AI-powered tools can expand service availability while reducing administrative burdens. Their research suggests that successful AI implementation requires not just technical capabilities but also organizational readiness and user-centered design—factors that align closely with the broader digital governance challenges identified in this study. While e-governance remains relevant as a foundational element of digital transformation, particularly in regions still struggling with basic digital infrastructure and literacy, understanding the trajectory toward AI integration provides important context for strategic planning. As Desouza et al. (2021) argued, digital transformation in public administration should be viewed as an evolutionary process, with each stage building on previous capabilities. For regions like Antique Province, establishing strong e-governance capabilities represents a critical stepping stone toward more advanced AI applications in the future. This study acknowledges the importance of AI as the emerging frontier in digital governance while focusing on the foundational elements necessary for any successful digital transformation. The findings related to infrastructure limitations, digital literacy, and organizational readiness in Antique Province will inform not only immediate e-governance initiatives but also longer-term planning for AI integration in local governance.

The Impact of Data Utilization on Governance. Data-driven decision-making is an emerging trend in public administration, where data analytics provide actionable insights for resource allocation and policy planning. Previous research by Kim et al. (2021) emphasized the role of data utilization in enhancing public sector efficiency, noting that LGUs that adopt data-driven practices are better positioned to respond to local needs and challenges. This has been further supported by Lim and Lee (2022), who found that data-driven governance improves accountability and transparency in decision-making processes. However, rural LGUs in agricultural economies, such as those in Antique Province, often struggle with data collection, analysis, and application due to limited technical expertise and inadequate infrastructure. Alonzo et al. (2023) pointed out that rural areas must overcome infrastructural gaps to unlock the full potential of data utilization, which would allow local governments to adopt more targeted and effective policies. Gil-Garcia et al. (2019) provide a more nuanced analysis of the relationship between digital governance and public management, arguing that successful data utilization requires not just technical capabilities but also appropriate governance structures and organizational processes. Their research suggests that the mere availability of data does not guarantee its effective use in decision-making; rather, organizations need to develop a data culture and appropriate data governance frameworks.

Bridging the Digital Divide in Rural LGUs. Efforts to bridge the digital divide in rural LGUs require a multifaceted approach, combining investments in digital infrastructure with comprehensive training and capacity-building programs. Studies conducted by Perez et al. (2022) indicate that ICT infrastructure development, coupled with targeted training programs, can substantially reduce the digital divide in rural areas. They argue that an integrated approach, which includes policy reforms, public-private partnerships, and citizen engagement, is crucial for sustainable digital transformation in local governance. Raynes and Warren (2021) provide important insights into successful models of rural digital transformation, highlighting cases where community-based approaches have effectively addressed local challenges. Their research emphasizes the importance of contextualizing digital solutions to local needs and capabilities rather than imposing standardized models developed for urban contexts. The existing literature highlights the critical role of digital literacy and data utilization in enhancing the effectiveness of LGUs, particularly in rural regions like Antique Province. The digital divide remains a persistent challenge that requires targeted interventions in the form of infrastructure development, training programs, and strategic capacity-building. However, there remains a gap in understanding the specific dynamics of digital transformation in agricultural contexts like Antique Province, where unique challenges and

opportunities exist. This study aims to contribute to this body of knowledge by assessing the current state of computer literacy and data utilization among LGU personnel in Antique Province and providing evidence-based recommendations for improving governance efficiency.

Methods

This study employs a mixed-methods approach, combining both quantitative and qualitative data collection techniques. The integration of these methods allows for a comprehensive analysis of computer literacy and data utilization among Local Government Units (LGUs) in Antique Province. This approach provides the benefit of capturing numerical data to represent general trends while also obtaining in-depth insights to understand the nuanced challenges and needs of LGUs. The mixed-methods design employed in this study follows Creswell and Plano Clark's (2018) convergent parallel approach, where quantitative and qualitative data are collected concurrently, analyzed separately, and then integrated during interpretation. This methodology was selected based on its demonstrated effectiveness in addressing complex research questions in public administration research (Mele & Belardinelli, 2019). As Johnson and Onwuegbuzie (2004) argue, mixed methods provide complementary strengths that offset the limitations of single-method approaches, allowing for a more comprehensive understanding of multifaceted phenomena such as digital governance. In the context of this study, quantitative methods help identify patterns and relationships between variables, while qualitative methods illuminate the contextual factors and lived experiences that shape digital practices in local government units. This integration is particularly important for research in developing contexts, where standardized measures alone may fail to capture the nuanced challenges of digital transformation (Bertrand et al., 2021).

Study Design

This research adopts a cross-sectional design, which collects data from participants at a specific point in time. Unlike longitudinal studies that track changes over time, the cross-sectional approach allows for a snapshot of the current digital landscape within Antique's LGUs. This methodology is advantageous because it efficiently captures key variables such as computer literacy levels and data utilization practices while also accommodating time constraints typical of public administration studies. The study integrates quantitative surveys, qualitative interviews, focus group discussions (FGDs), and secondary data analysis. This combination facilitates a robust and multidimensional analysis, capturing both the breadth of digital governance practices through quantitative data and the depth of personal experiences and systemic challenges through qualitative insights. By employing multiple data sources, this study mitigates the risk of method bias and strengthens the overall validity of the findings.

Sampling

The stratified random sampling technique employed in this study follows Neyman's (1934) optimal allocation approach, which maximizes precision for a given sample size by distributing the sample proportionally across strata (Thompson, 2012). The stratification process was guided by Cochran's (1977) principles for multi-stage sampling in geographically dispersed populations. To determine appropriate sample size, we used Krejcie and Morgan's (1970) formula for finite populations, with a 95% confidence level and a 5% margin of error. The resulting sample of 100 participants represents approximately 12% of the total population of local government personnel in Antique Province.

The stratification variables (urban/rural location, size of local government unit, and economic sector focus) were selected based on their established relevance to digital governance outcomes in previous studies (Gil-García & Pardo, 2018; Jiang & Xu, 2021). To ensure the validity of the stratification process, we conducted a preliminary analysis of population characteristics using administrative data obtained from the Provincial Government of Antique. This analysis confirmed sufficient variation across the selected stratification variables to warrant their inclusion in the sampling design.

Random selection within strata was performed using a computerized random number

generator (Research Randomizer, Version 4.0), as recommended by Urbaniak and Plous (2013) for ensuring unbiased selection in applied field research. To address potential non-response, we initially selected 120 participants (20% more than the target sample size) and achieved an 83.3% response rate, resulting in the final sample of 100 participants.

The study employed a stratified random sampling technique to select 100 LGU personnel from across all municipalities and cities in Antique Province. This approach was chosen to ensure that both rural and urban areas were adequately represented in the sample, reflecting the province's diverse digital landscape. The total population of LGU personnel in Antique Province is composed of administrative and technical staff responsible for governance, decision-making, and public service delivery. From this population, the sample size of 100 was determined to provide a balance between feasibility and statistical representativeness, allowing for meaningful analysis of the results.

Stratification Process

To account for the geographical diversity of Antique Province, the population was divided into strata based on several criteria. First, LGUs were grouped into urban and rural areas to ensure proportional representation of different geographic regions. Second, the size of the LGUs was considered, with larger LGUs, such as cities, being distinguished from smaller municipalities to reflect differences in resources and governance structures. Finally, LGUs were stratified based on their economic sector focus, categorizing them according to their involvement in agriculture, public services, or other sectors. This approach ensured a comprehensive representation of the province's diverse characteristics. Each stratum was assigned a proportionate number of participants, ensuring that each subgroup of the population was adequately represented in the final sample. For instance, if rural areas constitute 70% of the total population of LGU personnel, then 70 out of the 100 participants were randomly selected from the rural strata.

Random Selection Process

Within each stratum, the participants were randomly selected using a random number generator to avoid bias in the selection process. Lists of eligible LGU personnel from each stratum were obtained, and each individual was assigned a number. The random number generator was then used to select personnel from these lists until the required number of participants from each stratum was reached. This method ensured that the sample was not only representative of the entire province but also reflective of the varying levels of computer literacy, digital infrastructure, and governance challenges experienced across different LGUs in Antique. The stratified random sampling technique offers a more comprehensive and nuanced understanding of the digital divide by capturing the experiences of LGUs across diverse settings, from well-connected urban areas to more isolated rural regions.

Survey

The survey was designed as the primary quantitative data collection method to assess the computer literacy and data utilization practices of Local Government Unit (LGU) personnel in Antique Province. It aimed to provide a comprehensive understanding of digital skills, tool usage, and data-driven decision-making processes across a representative sample of LGUs. A structured questionnaire was developed, incorporating both closed-ended and Likert scale questions, covering four key areas: demographic information, computer literacy, digital tool usage, and data

utilization. Demographic questions gathered details on age, gender, educational background, job title, and length of service. The computer literacy section assessed proficiency in basic applications such as word processing, spreadsheets, and internet navigation, as well as advanced tools like database management and data analytics platforms. The digital tool usage section focused on the types and frequency of tools used for governance, e-services, and data management. The data utilization section explored the role of data in decision-making, policy formulation, and service delivery, including the accessibility of data and the use of data analytics tools. To accommodate varying

levels of internet connectivity across the province, the survey was administered both online and in person. LGU personnel with reliable internet access received the digital version of

the survey via email or online platforms such as Google Forms. In areas with limited connectivity, paper-based surveys were distributed and completed with the assistance of trained field researchers, who ensured any questions or technical issues were resolved onsite.

To enhance response rates and accuracy, trained field personnel were deployed to facilitate paper surveys, while follow-up reminders were sent to online participants. The data collection period spanned three months, allowing adequate time for survey coordination in remote areas and ensuring all LGUs were covered. Before full deployment, the survey was pre-tested with a small group of LGU personnel to ensure the clarity of questions and reliability of the survey instrument. Feedback from the pre-test led to minor adjustments, refining the questions to better capture the required data.

Data Collection Methods

Key Informant Interviews: Key informant interviews were conducted with fifteen strategically selected participants, including LGU officials, IT professionals, and representatives from relevant government agencies. Participants were chosen based on their expertise, role within the LGU, and knowledge of digital governance initiatives. The selection process ensured diversity in terms of position, expertise, and geographical representation within the province. These semi-structured interviews allowed for the collection of detailed qualitative data on infrastructural challenges, resource constraints, and training needs faced by LGUs. The semi-structured format provided flexibility to explore specific areas of interest while maintaining a consistent framework across interviews. Each interview lasted approximately 60-90 minutes and was conducted by trained researchers who were knowledgeable about digital governance issues. The interviews were audio-recorded with participants' consent and later transcribed for analysis. To ensure accuracy, transcripts were shared with participants for verification (member checking). This approach enhanced the trustworthiness of the data and allowed participants to clarify or expand on their responses.

Focus Group Discussions (FGDs). Focus Group Discussions were held, involving three groups of 8-10 participants each, including LGU personnel and community representatives. Participants were selected to ensure diversity in terms of roles, experience, and geographical location within the province. Each group was carefully composed to include individuals from different municipalities, departments, and levels of digital literacy. These FGDs enabled the exploration of collective experiences and community perspectives on digital governance. Through interactive discussions, participants shared insights on the social dynamics and shared challenges of implementing digital initiatives that might not have emerged in individual interviews. Each FGD was facilitated by a moderator and an assistant moderator, who guided the discussion while ensuring all participants had equal opportunity to contribute. The FGDs were structured around key themes identified from the survey results and literature review, but allowed flexibility for emerging topics. Sessions were audio-recorded with participants' consent and lasted approximately 2-3 hours each. The recordings were later transcribed and analyzed alongside the interview data.

Secondary Data Analysis. To complement the primary data collection, secondary data sources such as government reports and datasets from the Philippine Statistics Authority were analyzed. This secondary data provided a comparative analysis of the current digital infrastructure and practices in Antique against regional and national trends. By including secondary data, the study enhanced its contextual understanding and ensured that the primary data was interpreted within a broader governance and policy framework.

Data Analysis

Quantitative Analysis. The quantitative analysis involved calculating descriptive statistics, such as mean, median, mode, and standard deviation, for continuous variables like age and computer literacy scores. This provided an overview of general trends in the data.

Advanced statistical techniques, including the Chi-Square Test of Independence (McHugh, 2020) and ANOVA (Ostertagová & Ostertag, 2021), were used to explore relationships between key variables such as education level and computer literacy, as well as to compare differences across LGUs. The Chi-Square tests assessed the association between categorical variables (e.g., educational attainment and computer literacy levels), while ANOVA compared means across different groups (e.g., literacy levels across different municipalities). Multiple regression analysis was also applied to identify predictors of data utilization, offering insights into how factors like internet connectivity, hardware availability, and training programs impact digital governance outcomes. The regression models were checked for assumptions of normality, linearity, homoscedasticity, and multicollinearity to ensure the validity of the results. All quantitative analyses were performed using SPSS version 27.0, with a significance level set at $p < 0.05$.

Qualitative Analysis. For the qualitative analysis, thematic analysis was conducted on data from interviews and FGDs, which helped identify recurring patterns and themes. This method provided a deeper understanding of the challenges and best practices faced by LGUs. The thematic analysis followed Braun and Clarke's (2006) six-step process: familiarization with the data, initial coding, searching for themes, reviewing themes, defining and naming themes, and producing the report. Two researchers independently coded the transcripts to enhance reliability, and any discrepancies were resolved through discussion. This methodological triangulation strengthened the validity of the findings by ensuring that themes were not the result of individual researcher bias. NVivo software version 12 was used to facilitate systematic coding and ensure a structured approach to identifying key themes within the qualitative data. Additionally, content analysis of secondary data allowed for the identification of trends and gaps in digital infrastructure and data utilization practices, helping to contextualize the primary data findings.

Integration of Quantitative and Qualitative Data. Following the separate analyses of quantitative and qualitative data, an integration phase was conducted to triangulate findings and develop a comprehensive understanding of the research questions. This integration followed a convergent parallel design, where quantitative and qualitative results were compared and contrasted to identify areas of convergence, divergence, and complementarity. The integration process involved creating joint displays that presented quantitative results alongside supporting qualitative themes and illustrative quotes. This approach allowed for a deeper understanding of the statistical findings by providing contextual explanations and lived experiences. For example, statistical correlations between education level and computer literacy were enriched by qualitative insights into the specific challenges faced by LGU personnel with different educational backgrounds.

Measures to Address Researcher Bias. Several measures were implemented to mitigate potential researcher bias in the study. First, the research team included members with diverse backgrounds in public administration, information technology, and rural development, which provided multiple perspectives during data collection and analysis. Second, reflexivity was practiced throughout the research process, with researchers maintaining reflective journals to document their assumptions, biases, and methodological decisions. Additionally, peer debriefing sessions were conducted regularly, where preliminary findings and interpretations were discussed among researchers to challenge assumptions and identify potential biases. Finally, member checking was employed for the qualitative component, where interview and FGD participants were invited to review summaries of the findings to ensure their perspectives were accurately represented.

Ethical Considerations

All participants provided written informed consent before participating in the study. Confidentiality was maintained through the anonymization of data, and all information was securely stored. The study protocol was approved by the Panel Review Board of the University of Antique ensuring that ethical standards were adhered to throughout the research process. Participants were informed of their

right to withdraw from the study at any time without consequences. All data collection activities were conducted in environments that ensured privacy and confidentiality. For participants who preferred to communicate in local dialects, trained translators were available to ensure accurate communication and understanding of the research process.

Validity and Reliability

To ensure the validity of the instruments, the survey and interview guides were pretested with a small sample of LGU personnel to ensure clarity and relevance. The survey instrument underwent content validity assessment by a panel of experts in digital governance and public administration, resulting in a Content Validity Index (CVI) of 0.87, indicating strong validity. Additionally, the internal consistency of the survey scales was assessed using Cronbach's alpha, with all scales exceeding the recommended threshold of 0.70 (ranging from 0.76 to 0.92).

The use of validated measures and thorough training of researchers strengthened the reliability of the data collection process. Consistency in survey administration and interview procedures further enhanced the reliability of the findings. For the qualitative components, an audit trail was maintained to document all methodological decisions and analytical procedures, enhancing the dependability and confirmability of the findings.

Data Integration and Synthesis

The integration of quantitative and qualitative data allows for a more comprehensive understanding of the challenges faced by LGUs. Quantitative data provides insights into numerical trends like the levels of computer literacy, while qualitative data offers personal and experiential insights into the barriers and opportunities in adopting digital technologies. This integrated approach ensures that the study's recommendations are grounded in both statistical evidence and real-world experiences from LGUs, making them more actionable and context-specific.

Result and Discussion

This section presents the findings from the quantitative surveys, qualitative interviews, focus group discussions, and secondary data analysis, followed by a comprehensive discussion of the implications of these findings.

Table 1. Demographic Profile of the Respondents

Characteristics	Category	Frequency (n = 100)	Percentage (%)
Gender	Male	52	52%
	Female	48	48%
Age Range	18 – 29	24	24%
	30 – 44	42	42%
	45 – 60	34	34%
Educational	High School Graduate	8	8%
Background	College Graduate	62	62%
	Post Graduate	30	30%
Position Level	Entry-Level	35	35%
	Mid-Level	45	45%
	Senior-Level	20	20%
Years of Service	< 5 years	28	28%
	5 – 10 years	42	42%
	> 10 years	30	30%
LGU Type	Rural	68	68%
	Urban	32	32%

Table 1 presents the demographic profile of the 100 LGU personnel who participated in the survey. The gender distribution was relatively balanced, with 52% male and 48% female respondents. The largest age group was 30-44 years (42%), followed by those aged 45-60 (34%), and younger individuals aged 18-29 (24%). In terms of educational attainment, the majority (62%) were college graduates, while 30% held postgraduate qualifications, and only 8% had completed high school as their highest level of education. Regarding position levels within the LGUs, 45% of respondents held mid-level positions, 35% were in entry-level positions, and 20% occupied senior-level roles. When examining years of service, 42% had worked for 5-10 years, 30% had more than 10 years of experience, and 28% had less than 5 years of service. The majority of respondents (68%) were from rural LGUs, while 32% were from urban areas, reflecting the predominantly rural nature of Antique Province.

Table 2. Computer Literacy and Digital Tool Usage

Category	Survey Questions	Response	Frequency (n=100)	Percentage (%)
Computer Literacy	Proficiency in Using Productivity Software (Word, Excel, Powerpoint))	Beginner	30	30%
		Intermediate	50	50%
		Advanced	20	20%
	Familiarity with Online Platforms for Governance (email, cloud storage, e-services)	Low	18	18%
		Moderate	46	46%
		High	36	36%
	Ability to Troubleshoot Basic Computer Issues	Low	45	45%
		Moderate	40	40%
		High	15	15%
	Understanding of Data Security Principles	Low	55	55%
		Moderate	35	35%
		High	10	10%
Digital Tool Usage	Use of Data Management Tools (databases, data analytics)	Rarely	40	40%
		Occasionally	45	45%
		Frequently	15	15%
	Use of Software Applications for Public Services (Tax Collection, Social Services)	Rarely	35	35%
		Occasionally	50	50%
		Frequently	15	15%
	Use of Digital Communication Tools (video conferencing, messaging apps)	Rarely	20	20%
		Occasionally	45	45%
		Frequently	35	35%
	Use of Digital Platforms for Citizen Engagement	Rarely	50	50%

Category	Survey Questions	Response	Frequency (n=100)	Percentage (%)
		Occasionally	35	35%
		Frequently	15	15%

Table 2 presents detailed findings on computer literacy and digital tool usage among LGU personnel. In terms of proficiency with productivity software, half of the respondents (50%) reported intermediate-level skills, while 30% considered themselves beginners, and 20% were advanced users. Regarding familiarity with online platforms for governance, 46% reported moderate familiarity, 36% reported high familiarity, and 18% reported low familiarity.

The ability to troubleshoot basic computer issues was predominantly low (45%) or moderate (40%), with only 15% reporting high competence in this area. Similarly, understanding of data security principles was limited, with 55% reporting low understanding, 35% moderate, and only 10% high.

For digital tool usage, results revealed occasional (45%) or rare (40%) use of data management tools, with only 15% using them frequently. Software applications for public services showed a similar pattern, with 50% occasional use, 35% rare use, and 15% frequent use. Digital communication tools were more commonly used, with 35% reporting frequent use, 45% occasional use, and 20% rare use. However, digital platforms for citizen engagement were rarely used by half of the respondents (50%), occasionally used by 35%, and frequently used by only 15%. These findings reveal significant gaps in advanced digital competencies and limited integration of digital tools in governance processes, particularly for data management and citizen engagement.

Table 3. Data Utilization Patterns

Category	Survey Questions	Response	Frequency (n=100)	Percentage (%)
Data Utilization	Frequency of Data Use in Decision-Making (data analysis, evidence-based policy formulation)	Rarely	42	42%
		Occasionally	40	40%
		Frequently	18	18%
	Availability of Data Analytics Tools for LGU Personnel	Not Available	55	55%
		Partially Available	35	35%
		Fully Available	10	10%
	Collection of Digital Data for Service Planning	Rarely	38	38%
		Occasionally	42	42%
		Frequently	20	20%
	Use of Data Visualization in Reports and Presentations	Rarely	60	60%
		Occasionally	30	30%
		Frequently	10	10%
	Integration of Data from Multiple Sources	Rarely	65	65
		Occasionally	25	25
		Frequently	10	10

Table 3 provides insights into data utilization patterns among LGU personnel in Antique Province. The findings reveal limited use of data in decision-making processes, with 42% of respondents rarely using data for this purpose, 40% using it occasionally, and only 18% using it frequently. This limited utilization is partly explained by the lack of availability of data analytics tools, with 55% reporting that such tools are not available to them, 35% reporting partial availability, and only 10% having full access.

The collection of digital data for service planning follows a similar pattern, with 38% rarely collecting such data, 42% collecting it occasionally, and 20% doing so frequently. Data visualization techniques, which can enhance the accessibility and interpretability of data, are rarely used by 60% of respondents, occasionally used by 30%, and frequently used by only 10%. Similarly, the integration of data from multiple sources—a practice that can provide more comprehensive insights—is rarely done by 65% of respondents, occasionally done by 25%, and frequently done by just 10%.

These findings collectively indicate that data-driven governance practices are not yet well-established in Antique Province's LGUs, with significant limitations in both the tools and practices necessary for effective data utilization.

Table 4. Key Barriers to Digital Adoption

Category	Survey Questions	Response	Frequency (n=100)	Percentage (%)
Infrastructure Barriers	Limited Access to Digital Infrastructure (computer, internet)	Yes	60	60%
		No	40	40%
	Inadequate Internet Speed for Digital Operations	Yes	75	75%
		No	25	25%
	Unstable Power Supply Affecting Digital Work	Yes	45	45%
		No	55	55%
Resource Constraints	Insufficient Budget for Digital Tools and Systems	Yes	80	80%
		No	20	20%
	Limited IT Support Staff	Yes	70	70%
		No	30	30%
Skills and Training	Insufficient Training Opportunities for Digital Tools	Yes	70	70%
		No	30	30%
	Limited Understanding of Data-Driven Decision-Making	Yes	65	65%
		No	35	35%
Organizational Factors	Resistance to Change in Adopting Digital Technologies	Yes	45	45%
		No	55	55%
	Lack of Leadership Support for Digital Initiatives	Yes	40	40%
		No	60	60%
	Absence of Clear Digital Transformation Strategy	Yes	75	75%
		No	25	25%

Table 4 presents the key barriers to digital adoption identified by LGU personnel in Antique Province. These barriers are categorized into four main areas: infrastructure barriers, resource constraints, skills and training issues, and organizational factors.

In terms of infrastructure barriers, 60% of respondents reported limited access to digital infrastructure such as computers and internet connectivity. An even larger proportion (75%) identified inadequate internet speed as a significant challenge for digital operations. Additionally, 45% reported that unstable power supply affects their digital work.

Resource constraints were widely reported, with 80% of respondents citing insufficient budget allocation for digital tools and systems, and 70% noting a shortage of IT support staff. These financial and human resource limitations significantly hamper the ability of LGUs to implement and maintain digital systems.

Skills and training emerged as another major barrier, with 70% of respondents reporting insufficient training opportunities for digital tools and 65% acknowledging limited understanding of data-driven decision-making principles and practices. These findings suggest a critical need for capacity-building initiatives focused on developing digital skills among LGU personnel.

Organizational factors also play a role in hindering digital adoption. While resistance to change (45%) and lack of leadership support (40%) were reported by fewer than half of the respondents, a substantial 75% identified the absence of a clear digital transformation strategy as a significant barrier. This suggests that even when individual resistance is not the primary issue, the lack of strategic direction can impede progress in digital transformation efforts.

Table 5. Best Practices and Collection Initiatives

Category	Survey Questions	Response	Frequency (n=100)	Percentage (%)
Collaboration	Instances of Collaboration for Digital Transformation (partnership with NGOs or Academic Institutions)	Yes	35	35%
		No	65	65%
	Inter-LGU Knowledge Sharing on Digital Practices	Yes	30	30%
		No	70	70%
Successful Initiatives	Implementation of At Least One Successful Digital Project	Yes	55	55%
		No	45	45%
	Local Innovation in Digital Service Delivery	Yes	25	25%
		No	75	75%
Future Outlook	Willingness to Participate in Future Capacity-Building Initiatives	Yes	80	80%
		No	20	20%
	Belief in Importance of Digital Transformation for LGU Effectiveness	Yes	90	90%
		No	10	10%

Table 5 provides insights into best practices, collaborative initiatives, and the outlook for digital transformation among LGUs in Antique Province. In terms of collaboration, only

35% of respondents reported instances of partnership with NGOs or academic institutions for digital transformation purposes, while 65% reported no such collaborations. Similarly, inter-LGU knowledge sharing on digital practices was reported by only 30% of respondents, indicating limited horizontal learning and collaboration among LGUs in the province.

Regarding successful initiatives, 55% of respondents reported the implementation of at least one successful digital project in their LGU, suggesting that despite the challenges, more than half of the LGUs have managed to implement some form of digital initiative. However, local innovation in digital service delivery was reported by only 25% of respondents, indicating that most digital initiatives may be adoptions of standard solutions rather than innovations tailored to local contexts.

The future outlook appears positive, with 80% of respondents expressing willingness to participate in future capacity-building initiatives. Even more encouragingly, 90% of respondents acknowledged the importance of digital transformation for enhancing LGU effectiveness. This strong recognition of the value of digital transformation, coupled with high willingness to engage in capacity building, suggests a positive foundation for future digital governance initiatives in the province.

Table 6. Chi-Square Test of Independence

Variables	Chi-Square Value	Degrees of Freedom	p- Value	Significance
Education Level vs. Computer Literacy Level	15.6	4	0.003	Significant
Age vs. Digital Tool Usage	12.3	4	0.015	Significant
Urban/Rural Location vs. Data Utilization	9.8	2	0.007	Significant
Position Level vs. Data Analytics Skills	11.2	4	0.024	Significant
Years of Service vs. Resistance to Change	7.4	4	0.116	Not Significant

Table 6 presents the results of Chi-Square Tests of Independence conducted to examine relationships between various demographic factors and digital competencies. A significant relationship ($?^2 = 15.6$, $p = 0.003$) was found between education level and computer literacy, indicating that higher education levels are strongly associated with better computer literacy skills among LGU personnel.

Age was also significantly related to digital tool usage ($?^2 = 12.3$, $p = 0.015$), with younger personnel generally reporting more frequent use of digital tools. Similarly, the urban/rural location of LGUs was significantly associated with data utilization ($?^2 = 9.8$, $p = 0.007$), with urban LGUs showing higher levels of data utilization compared to rural LGUs.

Position level within the LGU was significantly related to data analytics skills ($?^2 = 11.2$, $p = 0.024$), with personnel in higher positions generally reporting better skills in this area. However, the relationship between years of service and resistance to change was not statistically significant ($?^2 = 7.4$, $p = 0.116$), suggesting that resistance to digital adoption is not necessarily related to length of service in the LGU.

These findings highlight the importance of considering demographic and organizational factors when designing capacity-building initiatives, as different groups may have different needs and barriers to digital adoption.

Table 7. ANOVA Analysis of Computer Literacy Across LGU Types

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F- Value	p- Value
Between Groups	24.5	3	8.17	5.32	0.02
Within Groups	95.2	62	1.54	-	-
Total	119.7	65	-	-	-

Table 7 presents the results of an ANOVA analysis examining differences in computer literacy levels across different types of LGUs (categorized by size and urban/rural status). The significant F-value (5.32, p = 0.002) indicates substantial differences in computer literacy levels across these groups. Post-hoc tests (not shown in the table) revealed that urban LGUs had significantly higher computer literacy scores compared to rural LGUs, and larger LGUs (in terms of population served) had higher scores compared to smaller LGUs.

These findings suggest that geographic location and LGU size play important roles in shaping digital literacy levels, possibly due to differences in resources, infrastructure, and exposure to digital technologies. This highlights the need for targeted interventions that address these disparities to ensure equitable digital transformation across all LGUs in the province.

Table 8. Correlation Analysis

Variables	Correlation Coefficient (r)	p– Value	Significance
Training Sessions vs. Data Analysis Skills	0.65	0.001	Significant
Internet Connectivity vs. Digital Tool Usage	0.72	0.000	Significant
IT Support Availability vs. Data Utilization	0.58	0.003	Significant
Leadership Support vs. Digital Innovation	0.67	0.000	Significant
Age vs. Computer Literacy	-0.34	0.031	Significant

Table 8 presents correlation analyses examining relationships between various factors related to digital governance. A strong positive correlation (r = 0.65, p = 0.001) was found between the number of training sessions attended and data analysis skills, indicating that increased training is associated with improved data analytic capabilities among LGU personnel.

Internet connectivity quality showed an even stronger positive correlation with digital tool usage (r = 0.72, p = 0.000), highlighting the critical importance of infrastructure for enabling digital practices. Similarly, IT support availability was moderately correlated with data utilization (r = 0.58, p = 0.003), suggesting that technical support plays an important role in enabling data-driven practices.

Leadership support was strongly correlated with digital innovation (r = 0.67, p = 0.000), emphasizing the importance of organizational leadership in driving digital transformation. Age showed a weak negative correlation with computer literacy (r = -0.34, p = 0.031), suggesting that younger personnel tend to have slightly higher computer literacy levels, though this relationship is not as strong as other factors examined.

These correlations provide valuable insights into the interrelated factors that influence digital governance capabilities and practices in Antique's LGUs, highlighting potential leverage points for intervention.

Table 9. Multiple Regression Analysis

Variables	Coefficient (B)	Standard Error	t- Value	p– Value	Significance
Internet Connectivity	0.45	0.10	4.50	0.000	Significant
Hardware Availability	0.35	0.12	2.92	0.004	Significant
Training Programs	0.30	0.08	3.75	0.001	Significant
Leadership Support	0.25	0.09	2.78	0.007	Significant
Organizational Culture	0.22	0.11	2.00	0.048	Significant
Age	-0.10	0.07	-1.43	0.156	Not Significant
Gender	0.05	0.08	0.63	0.533	Not Significant

Table 9 presents the results of a multiple regression analysis identifying significant predictors of data utilization among LGU personnel. The model explains a substantial proportion of the variance in data utilization ($R^2 = 0.68$), indicating that the included variables collectively account for 68% of the variation in data utilization practices.

Internet connectivity emerged as the strongest predictor (B = 0.45, p = 0.000), followed by hardware availability (B = 0.35, p = 0.004) and training programs (B = 0.30, p = 0.001). Leadership support (B = 0.25, p = 0.007) and organizational culture (B = 0.22, p = 0.048) were also significant predictors, albeit with somewhat smaller effects. Demographic factors such as age and gender were not significant predictors of data utilization.

These findings suggest that improving data utilization requires a multifaceted approach addressing infrastructure (internet connectivity and hardware), human capacity (training), and organizational factors (leadership and culture). The insignificance of demographic factors indicates that effective data utilization is achievable regardless of age or gender when proper support systems are in place.

Qualitative Findings

The qualitative component of this study, comprising key informant interviews and focus group discussions, provided rich contextual insights that complement the quantitative findings. Thematic analysis revealed several recurring themes, which are summarized in Table 10 and elaborated below.

Table 10. Thematic Analysis Results

Themes	Description	Frequency of Mention	Representative Quote
Infrastructural Barriers	Issues related to internet connectivity, hardware availability, and maintenance	22	"Our internet connection is so unstable that we often revert to manual processes because it's more reliable." - IT Officer, Rural Municipality
Resource Constraints	Financial limitations hindering the adoption of digital tools	18	"We have a vision for digital transformation, but our annual budget barely covers basic hardware needs, let alone advanced systems." - Municipal Treasurer
Need for Training	Necessity for comprehensive training programs in digital literacy and data usage	25	"Many of us want to use these new systems, but without proper training, we end up underutilizing them or making costly mistakes." - Administrative Officer
Community Engagement	Importance of involving local communities in digital initiatives	15	"Digital services only work when our citizens can access and use them. We need to consider their needs and capabilities in our digital planning." - Community Affairs Officer
Success Stories / Best Practices	Examples of successful e-governance implementations from other regions	12	"The neighboring municipality implemented a simple SMS-based reporting system that dramatically improved their re-

Themes	Description	Frequency of Mention	Representative Quote
			sponse time to community concerns. It didn't require expensive technology, just creative thinking." - Municipal Planning Officer
Leadership and Vision	Role of leadership in driving digital transformation	20	"The municipalities that are advancing in digital governance all have one thing in common - leaders who understand the value of technology and champion its adoption." - Provincial IT Coordinator
Integration Challenges	Difficulties in connecting different systems and data sources	16	"We have several digital systems, but they don't talk to each other. We end up with isolated data silos that don't give us the complete picture." - Data Management Staff

Infrastructural Barries

Infrastructure emerged as a critical challenge across all interviews and focus groups. Participants highlighted not only the limited availability of hardware but also the poor quality and reliability of internet connectivity in rural areas. As one IT officer from a rural municipality explained: "Our internet connection is so unstable that we often revert to manual processes because it's more reliable." This insight helps explain why, despite recognizing the importance of digital transformation, many LGUs continue to rely on traditional methods.

The issue of electricity stability was particularly pronounced in remote municipalities, with some reporting regular power outages that disrupt digital operations. A municipal planning officer noted: "We invested in computers and software, but without reliable electricity, they're often unusable. We need basic infrastructure solutions like generators or solar power before we can truly go digital."

Resource Constraints

Financial limitations were consistently identified as a major barrier to digital adoption. Beyond the initial investment in hardware and software, participants highlighted the ongoing costs of maintenance, upgrades, and IT support that strain already limited municipal budgets. A municipal treasurer shared: "We have a vision for digital transformation, but our annual budget barely covers basic hardware needs, let alone advanced systems."

Several participants noted that national funding for digital initiatives tends to favor larger urban centers, leaving rural LGUs at a disadvantage. A focus group participant suggested: "We need funding models that recognize the unique challenges of rural digitalization, perhaps with higher subsidies for areas with limited resources and infrastructure."

Need for Training

The importance of comprehensive training emerged as the most frequently mentioned theme across all qualitative data sources. Participants emphasized that hardware and software investments yield limited returns without adequate training for personnel. An administrative officer stated: "Many of us want to use these new systems, but without proper training, we end up underutilizing them or making costly mistakes."

Participants also highlighted the need for training that goes beyond basic computer skills to include data literacy, data security, and spe-

cific applications relevant to governance. A human resource officer noted: "Most training programs focus on basic computer operations, but we need more advanced training on data analysis and interpretation to actually use these systems for decision-making."

The discontinuity of training programs was identified as a particular challenge, with participants noting that one-off workshops rarely lead to sustained skill development. A senior administrator suggested: "We need continuous learning opportunities, not just occasional seminars. Perhaps a mentorship system where more experienced LGUs can guide others would be more effective."

Community Engagement

Participants emphasized that digital transformation should not focus solely on internal LGU operations but should also consider how digital tools can improve service delivery to citizens. A community affairs officer noted: "Digital services only work when our citizens can access and use them. We need to consider their needs and capabilities in our digital planning."

Several participants shared experiences of implementing digital initiatives without adequate community consultation, resulting in services that were underutilized or inappropriate for local needs. A focus group participant observed: "We need to assess digital literacy among our citizens and design services accordingly. In some communities, SMS-based services might be more accessible than web applications."

Success Stories and Best Practices

Despite the challenges, participants shared examples of successful digital initiatives that could serve as models for other LGUs. These success stories often involved simple, low-cost solutions tailored to local needs rather than complex systems. A municipal planning officer shared: "The neighboring municipality implemented a simple SMS-based reporting system that dramatically improved their response time to community concerns. It didn't require expensive technology, just creative thinking."

Participants noted that successful digital initiatives typically shared certain characteristics: they addressed a specific, well-defined problem; they were designed with extensive input from end-users; they included comprehensive training; and they had strong leadership support. These insights provide valuable guidance for future digital initiatives in the province.

Leadership and Vision

The role of leadership in driving digital transformation emerged as a critical theme. Participants observed that LGUs with leaders who prioritized and championed digital initiatives tended to make more progress, regardless of resource constraints. A provincial IT coordinator noted: "The municipalities that are advancing in digital governance all have one thing in common - leaders who understand the value of technology and champion its adoption."

Several participants suggested that raising awareness among LGU leaders about the benefits of digital transformation should be a priority. A focus group participant proposed: "Perhaps we need specialized workshops for mayors and other senior officials to help them understand how digital tools can address their governance priorities."

Integration Challenges

Participants highlighted the challenge of integrating different digital systems and data sources to create a cohesive digital ecosystem. A data management staff member explained: "We have several digital systems, but they don't talk to each other. We end up with isolated data silos that don't give us the complete picture."

This integration challenge extends beyond technical issues to include organizational silos, with different departments often reluctant to share data or coordinate digital initiatives. A senior administrator noted: "We need to break down the cultural barriers between departments. Digital transformation requires a whole-of-government approach, not isolated departmental efforts."

Integration of Quantitative and Qualitative Findings

The integration of quantitative and qualitative findings provides a more comprehensive understanding of the digital governance landscape in Antique Province. Several key areas of

convergence and complementarity emerged from this integration:

1 Infrastructure as a Foundation for Digital Transformation: The quantitative findings highlighted internet connectivity as the strongest predictor of data utilization (B = 0.45, p = 0.000), while infrastructure barriers were the second most frequently mentioned theme in the qualitative data. This strong convergence emphasizes that addressing infrastructure limitations is a prerequisite for any successful digital governance initiative in the province. The qualitative data further enriched this understanding by highlighting specific aspects of infrastructure challenges, such as electricity stability and maintenance issues, that were not captured in the quantitative survey.

2 The Critical Role of Training: Both data sources emphasized the importance of training, with quantitative data showing a strong correlation between training and data analysis skills (r = 0.65, p = 0.001), and qualitative data identifying training needs as the most frequently mentioned theme. The qualitative findings provided additional context by highlighting the need for continuous, comprehensive training that goes beyond basic skills to include data literacy and specific applications. This suggests that training initiatives should be designed as ongoing programs rather than one-time events, with content tailored to different skill levels and specific governance functions.

3 Leadership as a Catalyst: The regression analysis identified leadership support as a significant predictor of data utilization (B = 0.25, p = 0.007), while the qualitative findings emphasized the transformative role of leaders who champion digital initiatives. This convergence highlights the importance of engaging LGU leaders in capacity-building efforts, not just technical staff. The qualitative insights further suggested that leadership engagement could potentially compensate for resource limitations, with some resource-constrained LGUs making progress due to strong leadership commitment.

4 Organizational Culture and Change Management: Quantitative data identified organizational culture as a significant predictor of data utilization (B = 0.22, p = 0.048), while qualitative findings revealed specific cultural challenges such as departmental silos and resistance to data sharing. This suggests that capacity-building initiatives need to address not only technical skills but also organizational dynamics and change management. The qualitative insights provided specific examples of how organizational silos hinder digital integration, offering valuable context for designing interventions that address these cultural barriers.

5 Urban-Rural Disparities: The Chi-Square analysis showed a significant relationship between urban/rural location and data utilization ($?^2$ = 9.8, p = 0.007), with urban LGUs demonstrating higher utilization. The qualitative findings provided context for these disparities, highlighting factors such as infrastructure limitations, resource constraints, and lower exposure to digital technologies in rural areas. This integrated understanding suggests the need for differentiated capacity-building approaches that address the unique challenges of rural LGUs, potentially with additional support mechanisms to bridge the urban-rural digital divide.

6 Community-Centered Design: While the quantitative data focused on internal LGU capabilities, the qualitative findings emphasized the importance of considering citizen needs and capabilities in digital initiatives. This complementary insight highlights that effective digital governance extends beyond internal operations to include service delivery and citizen engagement. It suggests that capacity-building initiatives should include components on citizen-centered design and community engagement to ensure that digital services meet local needs and are accessible to the intended users.

This integration of findings provides a more nuanced understanding of the complex interplay of factors affecting digital governance in

Antique Province. It suggests that effective capacity-building initiatives must address not only technical skills and infrastructure but also organizational culture, leadership engagement, and community needs. The quantitative data identified significant predictors and relationships, while the qualitative insights provided context, explanations, and practical examples that enrich the overall understanding of the digital governance landscape.

Findings

This mixed-methods study involving 100 LGU personnel in Antique Province reveals significant challenges in digital governance implementation. The participants, predominantly from rural LGUs (68%) with college-level education (62%), demonstrated limited digital literacy and data utilization capabilities. While 50% reported intermediate proficiency in basic productivity software, critical deficiencies emerged in data security understanding (55% low comprehension) and technical troubleshooting (45% low ability). Most concerning, only 18% frequently used data in decision-making processes, with 55% lacking access to data analytics tools entirely.

Four primary barriers impede digital transformation: infrastructure limitations (75% citing inadequate internet speed), resource constraints (80% reporting insufficient budgets), skills gaps (70% identifying inadequate training opportunities), and organizational factors (75% lacking clear digital transformation strategies). Despite these challenges, 90% of respondents recognized the importance of digital transformation, and 80% expressed willingness to participate in capacity-building initiatives.

Statistical analyses revealed that internet connectivity was the strongest predictor of data utilization (B = 0.45, p = 0.000), followed by hardware availability and training programs. Urban LGUs significantly outperformed rural counterparts in digital capabilities, while education level and leadership support showed strong correlations with digital competencies. Qualitative findings reinforced these quantitative results, emphasizing infrastructure reliability issues, the need for comprehensive training beyond basic computer skills, and the critical role of committed leadership in driving digital initiatives.

The integrated findings indicate that while LGUs in Antique Province face substantial barriers to digital governance, there exists strong motivation and potential for improvement. Success requires a holistic approach addressing infrastructure development, sustained training programs, adequate resource allocation, and strategic leadership commitment, with particular attention to bridging the urban-rural digital divide.

Discussion

The integrated findings of this study reveal a multifaceted digital landscape in Antique Province's LGUs, characterized by significant disparities in computer literacy, digital tool usage, and data utilization practices. These disparities are influenced by a complex interplay of infrastructural, organizational, and human capacity factors that collectively shape the digital governance capabilities of LGUs in the province.

Digital Literacy Disparities and Their Implications

The varying levels of computer literacy among LGU personnel reflect broader patterns identified in previous research on digital governance in rural regions. The significant relationship between education level and computer literacy ($?^2$ = 15.6, p = 0.003) aligns with findings from Gunawan and Husin (2023), who noted that educational background significantly influences digital competency development. Similarly, the urban-rural disparities in computer literacy observed in this study echo the "digital divide" documented by van Deursen and Helsper (2020), who emphasized that geographical location often determines access to digital resources and learning opportunities.

However, this study extends previous research by exploring these disparities specifically in the context of agricultural regions like Antique Province. The qualitative findings revealed that in rural, agriculture-focused LGUs, basic computer literacy is further challenged by unreliable infrastructure, creating a cyclical problem where skills deteriorate due to

infrequent practice. As one IT officer noted, "Even staff who receive training often regress in their skills because they can't apply what they've learned consistently due to power outages or internet issues."

This finding aligns with Hong et al.'s (2022) theoretical framework, which argues that digital disparities stem not only from technical access but also from socio-cultural factors and institutional arrangements. In Antique's case, the disparities in computer literacy reflect not just individual capabilities but also structural inequalities in resource distribution and infrastructure development between urban and rural areas. This suggests that capacity-building initiatives must address these structural factors, not just individual skills, to be effective.

Barriers to Data-Driven Governance in Rural Contexts

The study's findings on limited data utilization in decision-making processes (42% rarely using data) highlight a significant gap between the potential of data-driven governance and its actual implementation in Antique Province. This gap is particularly concerning given that previous research by Kim et al. (2021) has established the critical role of data utilization in enhancing public sector efficiency and responsiveness.

The regression analysis identified several key predictors of data utilization, with infrastructure-related factors (internet connectivity and hardware availability) having the strongest influence. This finding supports Alonzo et al.'s (2023) argument that infrastructural limitations are primary barriers to data utilization in rural regions. However, our qualitative findings extend this understanding by revealing that infrastructure alone is insufficient; organizational factors such as leadership support ($B = 0.25$, $p = 0.007$) and organizational culture ($B = 0.22$, $p = 0.048$) also play crucial roles.

The importance of these organizational factors aligns with Gil-Garcia et al.'s (2019) argument that successful data utilization requires appropriate governance structures and organizational processes, not just technical capabilities. As one senior administrator explained in our qualitative findings, "We've seen municipalities with decent computers and internet still failing to use data effectively because departments won't share information or collaborate on analysis."

This suggests that efforts to promote data-driven governance in rural LGUs should adopt a socio-technical approach that addresses both infrastructure and organizational dynamics. The theoretical perspective offered by Wihlborg and Engström (2023), which emphasizes organizational change management as a critical component of digital transformation, provides a useful framework for understanding these dynamics in Antique Province.

The Role of Leadership in Digital Transformation

One of the most significant findings of this study is the critical role of leadership in driving digital transformation. Both quantitative and qualitative data highlighted leadership support as a key factor in successful digital initiatives. This finding is consistent with previous research by Tang and Ho (2022), who emphasized the importance of leadership commitment in e-governance implementation.

However, our study provides new insights into how leadership influences digital transformation specifically in resource-constrained rural contexts. The qualitative findings revealed that effective leaders in Antique Province compensate for resource limitations through strategic prioritization, creative problem-solving, and strong advocacy for digital initiatives. As one provincial IT coordinator noted, "The most digitally advanced municipalities aren't necessarily the wealthiest ones—they're the ones where mayors and department heads personally champion technology adoption."

This finding challenges the deterministic view that resource constraints inevitably hinder digital transformation. Instead, it suggests that leadership can serve as a mediating factor that enables progress despite limitations, a perspective that aligns with Raynes and Warren's (2021) research on successful models of rural digital transformation. This understanding has important implications for capacity-building initiatives, suggesting that leadership development should be a key component of any comprehensive digital governance program.

Contextualizing Digital Solutions for Agricultural Regions

The study's findings on limited local innovation in digital service delivery (only 25% reporting local innovation) highlight a gap in contextualizing digital solutions for the specific needs and constraints of agricultural regions like Antique Province. This gap is particularly significant given that the intersection of digital governance and agricultural development remains underexplored in the literature, as noted by Ramos and Fernandez (2023).

Our qualitative findings revealed that the most successful digital initiatives in Antique Province were those that addressed specific local challenges related to agricultural governance, such as systems for monitoring agricultural productivity, managing disaster response in rural areas, or coordinating agricultural extension services. As one municipal planning officer explained, "Generic e-governance solutions often don't work here because they don't account for our agricultural realities—seasonal variations in workload, limited connectivity in farming areas, or the specific information needs of our agricultural sector."

This observation aligns with Raynes and Warren's (2021) emphasis on contextualizing digital solutions to local needs rather than imposing standardized models. In agricultural regions like Antique, this contextualization requires a deep understanding of both digital governance principles and agricultural development challenges. The limited research at this intersection highlights a need for more targeted studies and knowledge exchange between digital governance and rural development experts.

Community Engagement and Citizen-Centered Design

While much of this study focused on internal LGU capabilities, the qualitative findings highlighted the importance of community engagement in digital transformation efforts. Participants emphasized that digital services must be designed with consideration for citizens' needs, capabilities, and access constraints, particularly in rural agricultural communities where digital literacy and connectivity may be limited.

This emphasis on citizen-centered design aligns with recent trends in e-governance research that highlight the importance of participatory approaches. Perez et al. (2022) argued that citizen engagement is crucial for sustainable digital transformation in local governance, a perspective supported by our findings from Antique Province. As one community affairs officer noted, "Digital services only work when our citizens can access and use them. We need to consider their needs and capabilities in our digital planning."

However, our study reveals that community engagement in digital initiatives remains limited in Antique Province, with most digital planning occurring without meaningful citizen input. This disconnects between service providers and users may partially explain the limited success of some digital initiatives in the province. The finding suggests that capacity-building initiatives should include components on community engagement methodologies and participatory design approaches to ensure that digital services meet local needs and capabilities.

Implications for Theory and Practice

The findings of this study have several important implications for both theory and practice in the field of digital governance, particularly in rural agricultural contexts.

From a theoretical perspective, our findings support the socio-technical view of digital transformation proposed by authors like Gil-Garcia et al. (2019) and Wihlborg and Engström (2023). This view emphasizes that successful digital transformation requires alignment between technical systems (hardware, software, connectivity) and social systems (organizational culture, leadership, skills). Our findings in Antique Province clearly demonstrate this interplay, with technical factors like internet connectivity ($B = 0.45$, $p = 0.000$) and social factors like leadership support ($B = 0.25$, $p = 0.007$) both significantly influencing data utilization.

Furthermore, our study contributes to the theoretical understanding of digital divides in governance contexts. The findings suggest that the digital divide in local governance contexts is multidimensional, encompassing not just

access to technology (first-level divide) but also skills to use it effectively (second-level divide) and the ability to translate digital capabilities into improved governance outcomes (third-level divide). This multidimensional conceptualization aligns with and extends van Deursen and Helsper's (2020) framework on digital inequalities.

From a practical perspective, the findings highlight several key considerations for policymakers and practitioners working on digital governance initiatives in rural regions:

1 Infrastructure as foundation: The strong influence of internet connectivity and hardware availability on data utilization underscores the need for continued investment in digital infrastructure, particularly in remote rural areas. However, these investments should be aligned with capacity-building initiatives to ensure that improved infrastructure translates into improved governance practices.
2 Tailored training approaches: The significant relationship between education level and computer literacy suggests that training programs should be tailored to different educational backgrounds and skill levels. Rather than one-size-fits-all approaches, more personalized and progressive training pathways are needed to effectively develop digital skills across diverse LGU personnel.
3 Leadership development: The critical role of leadership in driving digital transformation suggests that capacity-building initiatives should include specialized components for LGU leaders, focusing not just on technical awareness but also on change management strategies and digital vision development.
4 Organizational change management: The influence of organizational culture on data utilization highlights the need for change management approaches that address cultural barriers to digital adoption, such as departmental silos, resistance to data sharing, and preference for traditional processes.
5 Context-specific solutions: The limited local innovation in digital service delivery points to a need for more contextually appropriate digital solutions that address the specific challenges and needs of agricultural regions like Antique Province.
6 These practical implications provide a foundation for developing more effective capacity-building initiatives that address the multifaceted nature of digital governance challenges in rural contexts.

Conclusion

The comprehensive assessment of computer literacy and data utilization among Local Government Units (LGUs) in Antique Province provides crucial insights into the region's digital capabilities and data-driven practices. The findings emphasize the urgent need for targeted capacity-building initiatives aimed at empowering LGUs to leverage digital technologies and data for improved decision-making and service delivery.

Key Conclusions

This study revealed a diverse range of computer literacy levels and data utilization practices across LGUs in Antique Province. While some LGUs have made significant progress in digital transformation, others face substantial barriers that limit their ability to adopt digital technologies and data-driven approaches. These barriers include:

1 Infrastructure limitations: The study identified inadequate internet connectivity (60% reporting limited access), unstable power supply (45%), and insufficient hardware as significant barriers to digital adoption. As the strongest predictor of data utilization ($B = 0.45$, $p = 0.000$), infrastructure clearly serves as the foundation for digital governance.
2 Resource constraints: Financial limitations (80% reporting insufficient budget) and limited IT support staff (70%) significantly hinder LGUs' ability to invest in and maintain digital systems. These constraints are particularly pronounced in smaller, rural LGUs.
3 Skills gaps: The varying levels of computer literacy among LGU personnel, with only 20% reporting advanced skills in produc-

tivity software, highlight significant training needs. The strong correlation between training and data analysis skills ($r = 0.65$, $p = 0.001$) underscores the importance of capacity development.

4 Organizational and cultural challenges: Departmental silos, resistance to change (45%), and the absence of clear digital transformation strategies (75%) create organizational barriers to digital adoption. The qualitative findings revealed how these cultural factors can undermine even well-resourced digital initiatives.

Despite these challenges, the study identified several promising findings that provide a foundation for future progress:

1 Success stories and best practices: Some LGUs in the province have implemented successful digital initiatives that could serve as models for others. These success stories often involved simple, contextually appropriate solutions rather than complex systems.

2 Strong willingness to learn: The high percentage of respondents willing to participate in capacity-building initiatives (80%) indicates a positive attitude toward skill development and continuous learning.

3 Recognition of importance: The overwhelming acknowledgment of the importance of digital transformation for LGU effectiveness (90%) suggests a strong foundation of awareness upon which to build digital governance capabilities.

4 Leadership as a catalyst: The study identified leadership support as a significant predictor of digital innovation and data utilization, suggesting that engaged leaders can drive progress even in resource-constrained environments.

Based on these findings, it is evident that data-driven capacity building is not just a technological upgrade but a critical strategy for promoting sustainable development, enabling efficient resource allocation, and fostering responsive policymaking in Antique Province's LGUs.

Specific and Actionable Recommendations

Drawing from the integrated findings of this study, we propose the following specific recommendations to enhance computer literacy and data utilization among LGUs in Antique Province:

1 Strategic Infrastructure Development
- 1.1 Establish a Provincial Digital Infrastructure Fund specifically targeting underserved rural LGUs, with clear criteria for allocation based on connectivity needs.
- 1.2 Develop redundancy systems (e.g., solar power backup, offline-capable applications) to address electricity stability issues in remote areas.
- 1.3 Partner with telecommunications providers to implement special connectivity programs for government offices in remote areas, potentially through public-private partnerships.

2 Tiered Capacity Building Program
- 2.1 Implement a comprehensive, multi-level training program that addresses different skill levels and functional roles within LGUs:
- 2.2 Basic level: Fundamental computer operations and digital literacy for staff with limited experience
- 2.3 Intermediate level: Advanced applications, data management, and basic analysis for regular users
- 2.4 Advanced level: Specialized training in data analytics, system integration, and digital innovation for IT staff and department heads
- 2.5 Establish a "Digital Champions" program where trained personnel serve as internal trainers and mentors within their LGUs, creating a sustainable knowledge transfer mechanism.
- 2.6 Develop specific training modules for agricultural data management and analysis to address the unique needs of Antique's agriculture-focused LGUs.

3 Data Governance Framework
- 3.1 Develop a provincial data governance policy that standardizes data collection, storage, sharing, and security practices across all LGUs.

3.2 Establish data sharing protocols and platforms to facilitate inter-departmental and inter-LGU data exchange while maintaining appropriate security and privacy controls.
3.3 Create standardized data templates and reporting formats for key governance areas (e.g., agricultural production, disaster risk, public health) to enable comparability and aggregation of data across LGUs.

4 Leadership and Change Management
4.1 Conduct executive briefings and workshops specifically for mayors, department heads, and senior administrators on digital transformation leadership.
4.2 Establish a recognition program that highlights and rewards LGU leaders who successfully champion digital initiatives.
4.3 Develop change management toolkits that help leaders address resistance to change and manage the organizational transitions associated with digital adoption.

5 Collaborative Partnerships
5.1 Formalize partnerships with local academic institutions like the University of Antique to provide ongoing technical support, training, and research assistance to LGUs.
5.2 Establish a Provincial Knowledge Exchange Network where LGUs can share experiences, best practices, and innovations in digital governance.
5.3 Partner with national government agencies and international development organizations to secure additional funding and technical expertise for digital initiatives.

6 Context-Specific Digital Solutions
6.1 Develop and promote digital solutions specifically designed for agricultural governance, such as crop monitoring systems, farmer database management, and agricultural extension service coordination.
6.2 Create a digital innovation fund that provides seed funding for LGUs to develop locally appropriate digital solutions that address specific community needs.
6.3 Implement pilot projects in selected LGUs to test and refine digital approaches before broader rollout.

7 Community Engagement and Digital Inclusion
7.1 Establish citizen feedback mechanisms to ensure that digital services meet community needs and are accessible to the intended users.
7.2 Develop digital literacy programs for citizens, particularly in rural areas, to ensure they can access and benefit from LGU digital services.
7.3 Create multi-channel service delivery options (e.g., SMS, mobile apps, kiosks) that accommodate varying levels of digital access and literacy among citizens.

8 Monitoring and Evaluation System
8.1 Develop a comprehensive monitoring and evaluation framework with specific indicators to track progress in digital literacy, tool usage, and data utilization across LGUs.
8.2 Conduct regular assessments of digital maturity to identify areas for continued improvement and adjust capacity-building strategies accordingly.
8.3 Document and disseminate success stories and lessons learned to inform ongoing digital transformation efforts.

Policy Implications

The findings of this study have several important implications for policy development at both the provincial and national levels:

1 Differentiated Support Mechanisms: Policies should recognize the varying digital maturity levels across LGUs and provide differentiated support accordingly, with additional resources allocated to LGUs facing the greatest challenges.
2 Integrated Approach to Digital Development: Policy frameworks should address the interdependent nature of infrastructure, skills, and organizational factors in digital transformation, rather than treating them as separate domains.

3 Rural Digital Equity: National digital governance policies should include specific provisions and funding mechanisms to address the unique challenges of rural LGUs, particularly in agricultural regions like Antique Province.
4 Sustainability Planning: Policies should mandate sustainability planning for digital initiatives, including provisions for ongoing maintenance, upgrades, and skill development to ensure long-term viability.
5 Data-Driven Performance Management: Performance evaluation systems for LGUs should incorporate metrics related to digital governance and data utilization to incentivize progress in these areas.

By implementing these recommendations and policy adjustments, Antique Province can address the gaps identified in this study and empower its LGUs to harness the potential of digital technologies and data-driven approaches for improved governance and service delivery.

Future Research Directions

Based on the findings and limitations of this study, several directions for future research are recommended:

1 Longitudinal studies that track changes in digital literacy and data utilization over time, particularly following the implementation of capacity-building initiatives.
2 Comparative analyses across different provinces with similar agricultural contexts to identify broader patterns and generalizable insights about digital governance in rural regions.
3 In-depth case studies of successful digital transformation initiatives in resource-constrained LGUs to better understand the factors that enable success despite limitations.
4 Citizen perspective research that examines community experiences with and perceptions of LGU digital services to ensure that digital transformation efforts align with citizen needs.
5 Impact assessment studies that evaluate the tangible outcomes and benefits of digital transformation in terms of governance efficiency, service quality, and community development.

These research directions would complement the findings of the current study and contribute to a more comprehensive understanding of digital governance challenges and opportunities in rural agricultural contexts.

The findings of this study affirm that enhancing computer literacy and data utilization among LGUs in Antique Province is not merely a technical endeavor but a strategic imperative for effective governance and sustainable development. By addressing the identified gaps through targeted capacity-building initiatives, Antique Province can empower its LGUs to leverage digital technologies and data-driven approaches to better serve their communities and drive regional development.

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