



The Role of Digitalization as a Moderator of the Relationship Between Intellectual Capital and Public Service Quality at the Village Level

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ABSTRACT

This study aims to analyze the role of digitalization as a moderating variable in the relationship between intellectual capital and public service quality at the village level. The background of this research is based on the need for villages to improve the effectiveness of public services amid technological developments and growing public demands for fast, transparent, and accountable services. The study employed a quantitative approach using SEM PLS to examine both direct and moderating effects, involving 100 respondents consisting of village officials and service users. The findings reveal that intellectual capital significantly influences public service quality, and digitalization also contributes directly to enhancing service effectiveness. Furthermore, digitalization is proven to moderate the relationship between intellectual capital and service quality, indicating that the use of technology strengthens the contribution of human competencies in delivering higher quality services. The discussion highlights that the integration of intellectual capital and digitalization is essential for achieving modern and responsive village-level public services. This study concludes that improving the capabilities of village apparatus and increasing the adoption of digital technologies should be carried out simultaneously to support the transformation of village public services toward a more effective and community-oriented system.

Keywords: Digitalization, Intellectual Capital, Moderation, Public Service Quality, Village Governance

INTRODUCTION

The improvement of public service quality at the village level has become a strategic issue in national development because villages serve as the frontline administrative units that directly interact with the community, therefore institutional strengthening is increasingly important (Stoica & Radu, 2023). Social changes and public expectations for fast, accurate, and transparent services require villages to modernize their service governance systems (Smagulova et al., 2025). In addition, dynamic community needs demand that village officials abandon manual work patterns and replace them with more responsive and knowledge-based systems to achieve service effectiveness (Szymaniec-Mlicka, 2024). Village officials must be able to adapt to these developments in order to improve the quality of service interactions with society. Therefore, examining the internal factors that drive improvements in village public service quality has become increasingly crucial.

One of the internal factors that significantly strengthens the performance of village officials is intellectual capital, which includes competencies, experience, and the knowledge base within governmental organizations (Ma'ruf et al., 2026). Intellectual capital plays an important role in decision-making processes, service mechanism design, and information management within public organizations (Aini et al., 2025). Moreover, the ability of officials to utilize intellectual capital also influences village innovation capacity and responsiveness to emerging administrative and social challenges (Halim et al., 2026). Strong intellectual capital serves as a foundation for village officials to provide services more professionally. Thus, strengthening intellectual capital is a strategic necessity for improving public service quality in villages.

Furthermore, changes in the landscape of modern governance require village officials to manage information more systematically through the use of data-driven knowledge (Pokrovskaya et al., 2021). Understanding information processing, data analysis, and administrative documentation has become an essential part of intellectual capital to ensure that services can be delivered efficiently (Spitsyna & Golova, 2024). Village officials with higher capacity tend to interpret regulations more effectively, process documents more quickly, and respond to community needs in a more timely manner (Popov et al., 2019). Therefore, intellectual capital is a key aspect that determines the consistency of officials in delivering public services. Strengthening knowledge-based competencies is increasingly important within the context of service quality competition among villages.

The rapid development of information technology presents new challenges for villages in providing services that are relevant to community needs, particularly because digitalization has become an integral part of modern administration (Androniceanu et al., 2022a). Communities are now accustomed to accessing digital services that are faster, more efficient, and more transparent, which encourages village governments to adopt similar systems to remain competitive (Şvarc et al., 2021). If villages continue to rely on manual processes, delays in service delivery, communication barriers, and low public satisfaction are likely to occur (Kichigin & Gonin, 2020). Gaps in technological adoption also have the potential to deepen inequalities in service quality among villages. Therefore, digitalization has become an essential requirement for villages striving to adapt to modern governance developments.

Digitalization in village public services is not merely a technical tool, but also transforms work patterns, institutional structures, and organizational culture in significant ways (Androniceanu et al., 2022b). The implementation of digital technologies allows village officials to record population data, manage budgets, and administer services more quickly and accountably (Pirogova et al., 2020). In addition, digitalization enhances the quality of interactions between officials and the community through improved transparency of information (Stryzhak et al., 2021). This technological transformation creates substantial opportunities to improve the quality of village public services on a sustainable basis. Thus, digitalization is not only a trend but also a core strategy in strengthening village institutional capacity.

However, digitalization cannot operate optimally without being supported by adequate intellectual capacity among village officials who must operate, understand, and integrate digital systems into service processes (Gariba et al., 2025). The effectiveness of digitalization depends heavily on the human resource capacity of village officials to manage technology accurately, efficiently, and according to service needs (Khoruzhy et al., 2023). Limited intellectual capacity can hinder technology implementation, causing digitalization to become merely an administrative formality without producing real improvements in service quality (Vlasov, 2020). Therefore, the integration of digital skills and intellectual capital is a key factor in ensuring the success of village digitalization efforts. Both components complement one another in shaping innovation-based public services.

Considering these developments, it is evident that the quality of village public services is influenced by the synergy between the intellectual capacity of officials and the village's ability to implement digital technologies sustainably (Scafarto et al., 2023). Villages with strong intellectual capital tend to be more adaptive in optimizing digitalization as part of their service improvement processes (Schiavone et al., 2022). Digitalization can become a driving factor for creating more transparent, faster, and more responsive services when supported by adequate intellectual competence (Zaborovskaia et al., 2020). The combination of these two aspects is crucial to ensuring that the transformation of village public services is effective and aligned with modern societal demands. Therefore, the relationship between intellectual capital and digitalization becomes an important concept in understanding the dynamics of public service quality in villages.

Research on intellectual capital and digitalization in the public sector has been widely conducted as a foundation for developing modern service models. Atidira and Priyono (2020) found that the intellectual capital of local governments has a significant influence on strengthening institutional capacity in public service delivery. Ednoer et al. (2022) showed that intellectual capital directly contributes to improving governmental organizational performance through enhancements in employee competence. Firmansyah et al. (2025) revealed that the synergy between intellectual capital and digital leadership is capable of increasing the effectiveness of tax administration within the public sector.

In addition, several studies have highlighted the role of digitalization in supporting improvements in public service quality. Hidayat (2023) demonstrated that service digitalization enhances the speed, accuracy, and transparency of service delivery in local government institutions. Munizu et al. (2025) found that administrative digitalization is able to optimize public service processes at the subdistrict level by improving workflow efficiency. Mureşan (2023) explained that digitalization has a significant impact on increasing the efficiency of public administration while simultaneously strengthening organizational capacity in providing services to the community.

Although various studies have examined the roles of intellectual capital and digitalization in the public sector, there remains a gap in understanding how digitalization functions as a moderating variable in the relationship between intellectual capital and public service quality in the context of village governance. Most previous studies have focused on local government agencies, taxation offices, or district-level public sector institutions, which means they do not fully capture the unique dynamics of villages as frontline governmental units that interact directly with citizens. Furthermore, prior studies tended to examine intellectual capital and digitalization separately, which has not provided a holistic understanding of how both aspects interact to shape more effective and responsive public service quality at the village level.

Based on this gap, this study aims to analyze the influence of intellectual capital on village public service quality and to examine the role of digitalization as a moderating variable that strengthens the relationship between these two factors within the context of village governance. This research is expected to provide theoretical contributions by enriching the literature on the integration of intellectual capital and digitalization in the public sector, particularly at the village level which remains understudied. In addition, from a practical standpoint, this study provides recommendations for village governments on improving staff competencies and optimizing the use of digital technologies to create public services that are faster, more transparent, and more accountable.

RESEARCH METHODS

This study employs a quantitative approach using the Structural Equation Modeling Partial Least Squares (SEM-PLS) method to analyze the relationships among variables in the

research model. This approach was selected because it is capable of examining complex relationships involving latent variables and accommodates moderation analysis with greater flexibility compared to conventional statistical methods. SEM-PLS is also appropriate in research conditions that prioritize predictive analysis of variable relationships and do not require strict assumptions regarding data distribution. In addition, this method allows model testing with a relatively small sample size, making it suitable for village-level research that often faces limited access to respondents.

The population in this study consists of village officials and residents who have received public services in the selected research location. The sampling technique uses purposive sampling with criteria that require respondents to have direct experience in village public service processes. The sample size was determined to be 100 respondents, which is considered adequate for SEM-PLS analysis based on minimum recommendations for models with moderating complexity. Data collection was conducted by distributing questionnaires using a five-point Likert scale to measure the variables of intellectual capital, digitalization, and public service quality.

The research instrument was developed based on theoretical indicators relevant to each construct, then validated through validity and reliability testing in the outer model analysis stage. At this stage, indicators were evaluated using outer loading values, Average Variance Extracted (AVE), Cronbach's Alpha, and Composite Reliability to ensure that each construct possessed good internal consistency. Indicators with loading values below the minimum threshold were considered for elimination to strengthen and refine the measurement model. In addition, discriminant validity analysis was conducted to ensure that each construct was clearly distinguishable from other constructs within the model.



Figure 1. Research Model

After the measurement model was confirmed to be valid and reliable, the analysis proceeded to the inner model stage to assess the structural relationships among variables. This testing involved evaluating the R-square values to determine the predictive capability of the model, as well as analyzing the path coefficients that indicate the strength and direction of relationships between variables. The moderation model was tested by incorporating an interaction variable between intellectual capital and digitalization to determine whether digitalization strengthens or weakens the effect of intellectual capital on public service quality. Furthermore, the model's predictive relevance was assessed using Q-square values as indicators of predictive accuracy.

The final stage in the SEM-PLS analysis involved the bootstrapping procedure, which was used to test the statistical significance of the relationships among variables in the structural model. Bootstrapping was conducted by repeatedly resampling the data 5,000 times to obtain t-statistics and p-values for each path, including both direct effects and moderating effects. The

bootstrapping results served as the basis for determining whether the research hypotheses were accepted or rejected. Through this process, the combination of outer model analysis, inner model analysis, and bootstrapping provides a comprehensive understanding of construct validity, structural relationships, and the effectiveness of digitalization as a moderating variable within the research model.

RESULTS AND DISCUSSION

A. Result

As an initial step in presenting the research findings, this section provides an overview of the characteristics of the respondents who participated in this study.

Tabel 1. Responden Characteristics

Category	Subcategory	Number	Percentage
Gender	Male	58	58%
	Female	42	42%
Age	20–30 Years	34	34%
	31–40 Years	41	41%
	> 40 Years	25	25%
Education Level	High School or Equivalent	29	29%
	Diploma	18	18%
	Bachelor's Degree	46	46%
	Postgraduate	7	7%
Respondent Status	Village Apparatus	57	57%
	Public Service Users	43	43%

The table above shows that the survey respondents come from various backgrounds relevant to the context of public services at the village level, namely village apparatus and public service users. The majority of respondents are male with a percentage of 58 percent, while female respondents account for 42 percent. In terms of age, the largest group falls within the 31 to 40 year range at 41 percent, followed by respondents aged 20 to 30 years at 34 percent, and respondents over 40 years old at 25 percent. Regarding education, most respondents hold a bachelor's degree with a percentage of 46 percent, indicating a fairly good level of literacy in understanding the questionnaire. Additionally, 57 percent of the respondents are village apparatus and 43 percent are public service users, which reflects a balanced representation between service providers and service recipients.

Table 2. Descriptive Statistics of Research Variables

Variable	Mean	S. Dev	Min	Max
Intellectual Capital	4.21	0.56	3.00	5.00
Digitalization	4.18	0.61	2.80	5.00
Public Service Quality	4.25	0.59	3.10	5.00

The descriptive statistics indicate that the mean values for all variables are above 4, which shows that respondents tend to provide positive assessments of intellectual capital, the level of digitalization, and public service quality in the village. The public service quality variable has the highest mean value of 4.25, reflecting a very good perception of village services. The relatively small standard deviations across all variables, ranging from 0.56 to 0.61, indicate that respondents' answers are fairly homogeneous and do not show extreme variations. The minimum and maximum values that fall within the range of 3 to 5 further confirm the consistently high assessments across the three research variables.

The collected data were subsequently analyzed using the SmartPLS application to examine the quality of the measurement model and the structural relationships among variables in this study.

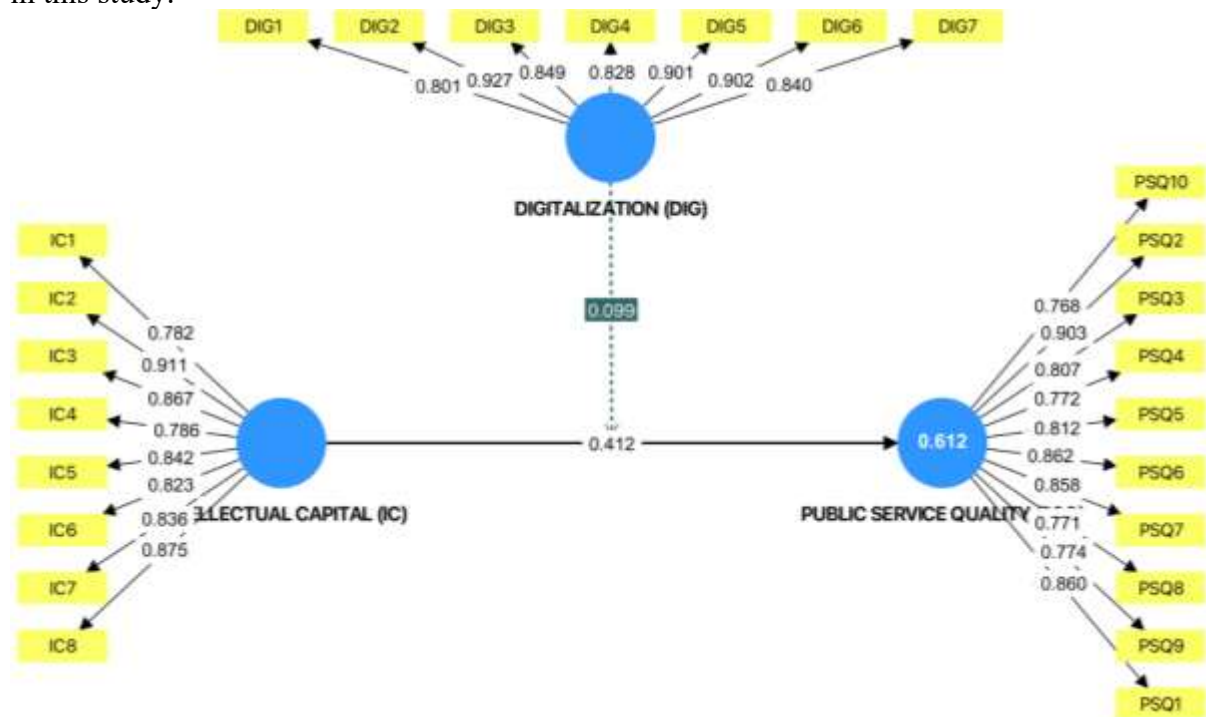


Figure 2. SmartPLS Output

The tested research model includes three main constructs, namely Intellectual Capital as the independent variable, Digitalization as the moderating variable, and Public Service Quality as the dependent variable. SmartPLS generates a path diagram that illustrates the direction of relationships among the variables as well as the magnitude of the indicator loadings in each construct. The model is used to evaluate measurement appropriateness through the outer model analysis and to assess structural relationships through the inner model analysis by incorporating the moderating effect of Digitalization on the relationship between Intellectual Capital and Public Service Quality. Through this model, the study can verify whether digitalization strengthens the influence of intellectual capital on the quality of public services at the village level.

As an initial step in evaluating the measurement model, the data were further analyzed through the outer model procedure to assess the validity and reliability of each research construct.

Table 3. Outer Model Results

Variable	Items	Outer Loading	AVE	CR
Intellectual Capital	IC1 - IC8	0.782 - 0.911	0.673	0.936
Digitalization	DIG1 - DIG7	0.801 - 0.927	0.698	0.945
Public Service Quality	PSQ1 to PSQ10	0.768 - 0.903	0.659	0.938

The outer model results indicate that all indicators of the three research variables have outer loading values above 0.70, which satisfies the criteria for convergent validity. The AVE values of the three variables are also above the minimum threshold of 0.50, indicating that each construct can explain more than half of the variance of its indicators. In addition, the composite reliability values for all constructs are far above the minimum requirement of 0.70, which confirms that the research instrument demonstrates very good reliability and consistency in measuring each construct.

At this stage, discriminant validity testing was conducted to ensure that each variable in the study is truly distinct from the others. The top row and the leftmost column represent the variables being evaluated. The numbers in the diagonal cells, which are presented in parentheses, represent the square roots of the AVE for each variable. The values below the diagonal indicate correlations between variables, while the numbers above the diagonal present the HTMT ratios as indicators of discriminant validity.

Table 4. Discriminant Validity (Fornell-Larcker and HTMT)

Variable	IC	DIG	PSQ
Intellectual Capital (IC)	(0.820)	0.612	0.589
Digitalization (DIG)	0.533	(0.836)	0.641
Public Service Quality (PSQ)	0.517	0.568	(0.812)

The discriminant validity results show that the square root of the AVE for each variable is higher than its correlation with other variables, which meets the Fornell-Larcker criteria. All HTMT values are also below the maximum threshold of 0.90, indicating that there are no issues related to construct discrimination. Therefore, the measurement model in this study can be considered valid and capable of clearly distinguishing each construct.

After confirming that the measurement model meets the required criteria, the next step was to analyze the significance of direct and indirect relationships between variables through the bootstrapping procedure.

Table 5. Significance of Direct and Moderation Paths

Relationship Between Variables	Path Coefficient (β)	t-statistic	p-value
IC \rightarrow PSQ	0.412	6.218	0.000
DIG \rightarrow PSQ	0.367	4.951	0.000
IC \times DIG (Moderation) \rightarrow PSQ	0.201	3.104	0.002

The results show that intellectual capital has a significant effect on public service quality with a p-value below 0.05. Digitalization also demonstrates a significant direct effect on public service quality. Furthermore, the interaction term between intellectual capital and digitalization has a t-statistic greater than 1.96 and a p-value below 0.05, which confirms that

digitalization significantly moderates the relationship between intellectual capital and public service quality. This indicates that the influence of intellectual capital on village service quality becomes stronger when the level of digitalization increases.

Subsequent analysis was conducted to evaluate the model's ability to explain the endogenous variable using the R-square value.

Table 6. R-Square Values

Endogenous Variable	R-Square
Public Service Quality (PSQ)	0.612

The R-square value of 0.612 indicates that intellectual capital, digitalization, and the moderating effect collectively explain approximately 61.2 percent of the variance in village public service quality. This value is categorized as strong within social science research using SEM-PLS methods, which means the model demonstrates substantial predictive capability toward the dependent variable.

Next, the effect size evaluation was carried out to determine how much each variable contributes to changes in the endogenous variable.

Table 7. Effect Size (f²)

Variable Relationship	f-square
Intellectual Capital → Public Service Quality	0.241
Digitalization → Public Service Quality	0.198
Intellectual Capital × Digitalization → Public Service Quality	0.067

The effect size results show that intellectual capital has a medium effect on public service quality, while digitalization contributes a small to medium effect. The moderating effect of digitalization is categorized as small, yet it remains statistically meaningful. This finding indicates that although the moderating role of digitalization is smaller compared to the direct effects of the main variables, it still plays an important role in strengthening the relationship between intellectual capital and public service quality.

Discussion

The findings of this study indicate that intellectual capital has a significant direct influence on the quality of public services at the village level. This result affirms that the competence, experience, and knowledge of village officials are essential foundations for delivering responsive and high quality services. This conclusion aligns with Atidira and Priyono (2020) who found that intellectual capital in local governments plays a crucial role in strengthening institutional capacity. Similar support is shown by Ednoer et al. (2022) who state that intellectual capital is a core factor in improving governmental organizational performance. In addition, the study by Firmansyah et al. (2025) also demonstrates that the integration of intellectual capital and digital leadership can enhance the effectiveness of public administration. All of these findings reinforce the argument that intellectual capital contributes directly to the quality of public services in villages.

Furthermore, this study shows that digitalization also exerts a significant influence on public service quality. Digitalization has been proven to improve the speed, transparency, and efficiency of administrative processes in villages, allowing citizens to receive better services. This result is consistent with Hidayat (2023) who explains that public service digitalization improves service speed and accountability in government institutions. Similar consistency can be observed in the findings of Munizu et al. (2025) who reveal that administrative digitalization

at the subdistrict office optimizes public service workflows. Additionally, Mureşan (2023) finds that digitalization is an essential element in improving the efficiency of public administration. All of this evidence indicates that digitalization plays a strategic role in enhancing public service quality at various levels of government.

The study also shows that the interaction between intellectual capital and digitalization has a significant effect on public service quality. This means that digitalization strengthens the ability of village officials to utilize their competencies and knowledge to deliver more efficient services. This explanation is in line with Huy and Phuc (2024) who find that the digitalization of accounting information systems can strengthen relationships among variables in public sector organizations, especially when adequate resource capacity is available. The findings of Kryshtanovych (2024) also support this view, stating that the intellectualization of officials' capacities must proceed alongside technological adoption to create modern service practices in the era of Society 5.0. Moreover, Oktari (2025) emphasizes that digitalization and human resource quality form a key combination in improving government public service performance. Therefore, this study confirms that intellectual capital will have a stronger impact on service quality when supported by a high level of digitalization.

The moderation test results show that digitalization functions not only as an independent variable that influences public service quality, but also as a catalyst that strengthens the contribution of village officials' intellectual capital. This finding is consistent with Novachenko et al. (2020) who assert that the use of information technology can improve the credibility, accuracy, and efficiency of public management when supported by sufficient knowledge capacity. Meanwhile, Ramírez et al. (2022) demonstrate that local governments with stronger intellectual capital tend to be more capable of adopting digitalization in the context of transparency and accountability in public services. The integration of these findings explains that the quality of public services in villages is not determined solely by technology or intellectual capital, but by the synergy between both elements in producing modern and effective service processes.

From the perspective of organizational governance, well structured digitalization can strengthen village service systems, yet its success depends heavily on the readiness of officials to manage the technology. This is consistent with Saputra et al. (2025) who state that cross institutional digitalization can improve service quality, yet it may also pose challenges when human resource capacity does not align with the digital systems implemented. Moreover, Stefan et al. (2025) explain that digitalization can function optimally only when supported by adequate enablers such as human resource competence, organizational structure, and technological readiness. Within the village context, the results of this study confirm that the success of digitalization in enhancing service quality is significantly influenced by the intellectual readiness of village officials as the primary enabling factor.

Compared to previous studies, this research offers new theoretical contributions because it identifies digitalization as a moderating variable rather than merely an independent variable. Earlier studies such as those conducted by Hidayat (2023), Munizu et al. (2025), and Oktari (2025) generally positioned digitalization as a direct determinant of service quality. In contrast, this study adds the perspective that digitalization can strengthen the relationship between intellectual capital and service quality, thereby offering a more comprehensive understanding of how technology mediates the capacity of officials in producing high quality public services. Thus, this research enriches existing literature and provides deeper insights into the strategic role of digitalization within village public service systems.

Although the study demonstrates strong relationships among variables, several limitations must be acknowledged. First, the sample of only one hundred respondents may not fully represent the diversity of village characteristics across broader regions. Second, the research relies solely on a quantitative design, which does not capture deeper insights about

the implementation dynamics of digitalization in practice, insights that could be explored through qualitative approaches. Third, the study focuses on three primary variables, which limits the exploration of other influential factors such as leadership, organizational culture, or infrastructure support that may also affect public service quality. Therefore, future research is recommended to use mixed methods, expand the sample coverage, and incorporate additional variables to strengthen understanding of how digitalization influences public service quality in villages.

CONCLUSION

This study demonstrates that intellectual capital has a significant influence on the quality of public services in villages, where the competence, experience, and knowledge capacity of village officials play an essential role in creating responsive and effective services. Digitalization is also found to have a direct effect on public service quality and significantly moderates the relationship between intellectual capital and service quality, meaning that a higher level of technological adoption in villages strengthens the contribution of intellectual capital to service quality. Therefore, this study affirms that the integration of the intellectual capabilities of village officials with the implementation of digital technology is a key factor in developing village public services that are modern, accountable, and aligned with community needs.

The results of this study have important theoretical and practical implications for the development of village governance. Theoretically, this research expands the literature on the relationship between intellectual capital, digitalization, and public service quality, particularly by examining the moderating role of digitalization, which has not been widely explored in the context of village administration. Practically, the findings can serve as a reference for village governments and policymakers to enhance the capacity of village officials through competency training, strengthened knowledge management, and improved digital literacy. Village governments also need to broaden the use of digital applications and systems as a strategy to accelerate service processes, increase transparency, and maintain public administrative accountability.

This study has several limitations that should be acknowledged, including the relatively limited sample size, which may not fully represent village conditions more broadly, and the use of a quantitative approach, which is not yet able to explain the details of digitalization implementation in the field. In addition, the study focuses on only three variables, leaving out other potential factors that may influence public service quality, such as leadership, organizational culture, or the availability of technological infrastructure. Therefore, future research is recommended to increase the sample size, employ a mixed-method approach, and incorporate other relevant variables to develop a more comprehensive and in-depth understanding of the dynamics of improving public service quality in villages.

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