

DIGITAL CAPITAL, SOCIAL INEQUALITY, AND TECHNOLOGICAL EXCLUSION IN RURAL COMMUNITIES OF PAKISTAN

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ABSTRACT

Digital transformation has become a key driver of socioeconomic development; however, unequal access to digital technologies and digital competencies continues to reinforce social disparities, particularly in rural communities of developing countries. This study examined the relationships among digital capital, social inequality, and technological exclusion in rural communities of Pakistan. Guided by Digital Capital Theory, the study investigated how digital capital influences technological exclusion directly and indirectly through social inequality. A quantitative, cross-sectional research design was employed, and data were collected from rural residents using a structured questionnaire. The collected data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) to assess the measurement and structural models. The findings revealed that digital capital had a significant negative effect on both social inequality and technological exclusion, while social inequality significantly increased technological exclusion. Furthermore, social inequality partially mediated the relationship between digital capital and technological exclusion, indicating that greater access to digital resources and stronger digital competencies reduce technological exclusion by improving socioeconomic opportunities. The study contributes to the literature by providing an integrated framework linking digital capital with social inequality and technological exclusion in the context of rural Pakistan. The findings offer important theoretical, practical, and policy implications for promoting digital inclusion through investments in broadband infrastructure, affordable internet access, digital literacy, and inclusive digital governance. Strengthening digital capital is essential for narrowing the rural digital divide and supporting sustainable socioeconomic development in Pakistan.

Keywords: Digital Capital, Social Inequality, Technological Exclusion, Rural Communities, Digital Inclusion, Pakistan.

INTRODUCTION

Digital technologies have become fundamental drivers of economic growth, educational advancement, social inclusion, and public service delivery in the twenty-first century. The rapid expansion of digital infrastructure has

transformed communication, commerce, healthcare, governance, and education across the globe. However, the benefits of digital transformation remain unevenly distributed, creating significant disparities in access to digital resources, technological skills, and online

opportunities. These disparities have given rise to the concept of digital capital, which encompasses individuals' access to digital technologies, digital competencies, and the ability to effectively utilize digital resources for socioeconomic advancement (Ragnedda, 2018).

Digital capital extends beyond the traditional notion of the digital divide by integrating both technological access and digital capabilities. Individuals possessing higher levels of digital capital are better positioned to access educational resources, employment opportunities, financial services, healthcare information, and government services through digital platforms. Conversely, populations with limited digital capital experience reduced opportunities for social mobility, economic participation, and civic engagement, thereby reinforcing existing patterns of social inequality (van Dijk, 2020).

Social inequality remains one of the most persistent development challenges in developing countries, particularly in rural communities where disparities in education, income, infrastructure, and technological access are more pronounced. In Pakistan, approximately two-thirds of the population resides in rural areas where limited internet connectivity, inadequate digital infrastructure, low literacy rates, gender disparities, and poverty continue to restrict digital inclusion. These structural inequalities have widened technological exclusion, preventing many rural households from benefiting from digital transformation initiatives in education, healthcare, agriculture, entrepreneurship, and e-governance (Pakistan Telecommunication Authority, 2024).

Technological exclusion refers to the inability of individuals or communities to access, afford, or effectively use digital technologies due to socioeconomic, geographical, educational, or institutional barriers. Rural populations frequently experience multiple forms of exclusion, including poor broadband infrastructure, limited ownership of digital devices, inadequate digital literacy, unreliable electricity, and insufficient institutional support. These challenges significantly reduce opportunities for economic

development and social participation while widening the digital divide between urban and rural populations (International Telecommunication Union [ITU], 2023).

Pakistan has introduced several national initiatives aimed at expanding broadband connectivity, promoting digital literacy, and enhancing digital governance. Despite these efforts, significant disparities persist between urban and rural communities regarding digital access, technological competencies, and digital service utilization. Consequently, digital inequality continues to influence educational achievement, employment opportunities, financial inclusion, healthcare accessibility, and overall socioeconomic development in rural regions.

Although previous studies have examined digital inequality and the digital divide, relatively limited research has investigated the interconnected relationships among digital capital, social inequality, and technological exclusion within rural communities in Pakistan. Existing studies often address these issues independently, overlooking their combined influence on rural development and social inclusion. Therefore, this study seeks to provide an integrated analysis of how digital capital influences social inequality and technological exclusion in rural Pakistan while offering evidence-based recommendations for promoting inclusive digital development.

Problem Statement

The rapid advancement of digital technologies has created unprecedented opportunities for economic development, education, healthcare, and governance. However, these benefits remain unevenly distributed, particularly in rural communities of Pakistan, where inadequate digital infrastructure, limited internet connectivity, low digital literacy, and socioeconomic disparities continue to hinder digital inclusion. As a result, many rural populations remain technologically excluded from essential digital services, reinforcing existing social and economic inequalities.

Despite national investments in digital transformation and broadband expansion, rural

communities continue to experience significant barriers to acquiring and utilizing digital technologies. Limited access to affordable internet services, digital devices, technological skills, and institutional support reduces opportunities for education, employment, entrepreneurship, financial inclusion, and access to public services. These challenges not only widen the urban–rural digital divide but also restrict sustainable socioeconomic development.

Existing research has largely focused on the digital divide or technological adoption independently, with relatively little attention given to the integrated role of digital capital in shaping social inequality and technological exclusion within Pakistan's rural context. This lack of comprehensive empirical evidence limits policymakers' ability to formulate effective digital inclusion strategies. Therefore, there is a need to investigate the relationships among digital capital, social inequality, and technological exclusion to provide practical recommendations for promoting equitable digital development in rural Pakistan.

Research Questions

- What is the relationship between digital capital and technological exclusion in rural communities of Pakistan?
- How does digital capital influence social inequality among rural populations?
- To what extent does social inequality contribute to technological exclusion in rural communities?
- What are the major barriers affecting digital inclusion in rural Pakistan?
- What policy interventions can enhance digital capital and reduce technological exclusion in rural communities?

Research Objectives

General Objective

To examine the relationship between digital capital, social inequality, and technological exclusion in rural communities of Pakistan.

Specific Objectives

- To examine the influence of digital capital on technological exclusion in rural communities.

- To investigate the relationship between digital capital and social inequality.
- To evaluate the effect of social inequality on technological exclusion.
- To identify the major barriers to digital inclusion in rural Pakistan.
- To propose policy recommendations for strengthening digital capital and reducing technological exclusion.

Significance of the Study

The study makes important theoretical, practical, and policy contributions to the growing literature on digital inequality and rural development. Theoretically, it extends existing knowledge by integrating the concepts of digital capital, social inequality, and technological exclusion into a unified framework within the context of rural Pakistan. The findings contribute to the broader discourse on digital inclusion and socioeconomic development in developing economies.

Practically, the study provides valuable insights for educators, development practitioners, community organizations, and digital service providers regarding the challenges faced by rural populations in accessing and utilizing digital technologies. The findings may assist stakeholders in designing targeted digital literacy programs, improving technological accessibility, and promoting equitable digital participation.

From a policy perspective, the study offers evidence-based recommendations for government agencies, telecommunications regulators, and development organizations responsible for digital transformation. The findings can support the formulation of policies aimed at expanding rural broadband infrastructure, enhancing digital literacy, reducing socioeconomic disparities, promoting affordable internet access, and strengthening inclusive digital governance. Ultimately, the study contributes to Pakistan's efforts to achieve sustainable digital development, reduce social inequality, and improve the quality of life in rural communities.

Literature Review

Underpinning Theory

Digital Capital Theory

This study is underpinned by Digital Capital Theory, proposed by Ragnedda (2018), which extends Pierre Bourdieu's theory of capital into the digital era. The theory argues that individuals' ability to benefit from digital technologies depends not only on physical access to digital devices and internet connectivity but also on their digital competencies, knowledge, and capacity to effectively utilize digital resources. Digital capital is conceptualized as a combination of digital access and digital skills, enabling individuals to acquire economic, social, educational, and cultural benefits through digital technologies.

Digital Capital Theory explains that unequal distribution of digital resources creates disparities in opportunities for education, employment, entrepreneurship, healthcare, financial inclusion, and civic participation. Individuals possessing higher levels of digital capital are more capable of participating in the digital economy, whereas those with limited digital capital experience technological exclusion and are more vulnerable to existing socioeconomic inequalities (Ragnedda & Ruiu, 2020).

Within the context of Pakistan, Digital Capital Theory provides an appropriate framework for understanding how deficiencies in digital infrastructure, affordability, digital literacy, and technological competencies contribute to social inequality and technological exclusion in rural communities. The theory suggests that strengthening digital capital through improved connectivity, education, and digital skills can reduce technological exclusion and promote inclusive socioeconomic development.

Digital Capital

Digital capital has emerged as an important concept in digital society research because it explains individuals' ability to access, utilize, and benefit from digital technologies. Unlike the traditional concept of the digital divide, which primarily emphasizes physical access to technology, digital capital incorporates both access

to digital infrastructure and the competencies required to effectively use digital technologies for socioeconomic advancement (Ragnedda, 2018).

Digital capital includes ownership of digital devices, internet accessibility, digital literacy, online communication skills, information evaluation, cybersecurity awareness, and the ability to participate effectively in digital environments. Individuals with greater digital capital are better equipped to obtain educational resources, employment opportunities, financial services, healthcare information, and government services through digital platforms (van Dijk, 2020).

In developing countries, digital capital has become increasingly important because digital transformation is rapidly reshaping economic activities and public service delivery. However, disparities in infrastructure, education, and income continue to create unequal access to digital opportunities, particularly among rural populations.

Social Inequality

Social inequality refers to unequal access to economic resources, education, employment opportunities, healthcare, political participation, and social mobility among different groups within society. These inequalities often arise from differences in income, education, gender, geographic location, ethnicity, and institutional support. In rural communities, limited infrastructure and reduced access to public services frequently intensify existing socioeconomic disparities.

Digital technologies have the potential to reduce social inequality by expanding access to information, education, financial services, and employment opportunities. Nevertheless, unequal access to digital technologies may instead reinforce existing inequalities by creating additional barriers to participation in the digital economy (van Deursen & Helsper, 2015).

In Pakistan, rural populations continue to experience lower educational attainment, limited employment opportunities, weaker digital infrastructure, and reduced access to online public services compared with urban populations.

Consequently, social inequality remains closely associated with disparities in digital access and technological capabilities.

Technological Exclusion

Technological exclusion refers to the inability of individuals or communities to access, afford, or effectively utilize digital technologies because of economic, educational, infrastructural, geographic, or institutional barriers. It represents a multidimensional phenomenon encompassing limited internet connectivity, lack of digital devices, inadequate digital literacy, affordability constraints, and poor technological infrastructure. Recent studies indicate that technological exclusion adversely affects educational achievement, employment opportunities, healthcare accessibility, financial inclusion, agricultural productivity, and civic participation. Individuals who are technologically excluded face increasing disadvantages as governments, businesses, and educational institutions continue to digitize essential services (International Telecommunication Union [ITU], 2023). In rural Pakistan, technological exclusion remains a major development challenge due to inadequate broadband infrastructure, unreliable electricity supply, low smartphone ownership, gender disparities, and insufficient digital literacy programs. These barriers limit participation in digital transformation initiatives and widen the urban-rural digital divide.

Digital Capital and Social Inequality

The relationship between digital capital and social inequality has received growing attention in contemporary research. Higher levels of digital capital improve individuals' ability to access education, employment, entrepreneurship, financial services, and healthcare through digital technologies, thereby reducing socioeconomic disparities. Conversely, limited digital capital

restricts opportunities for upward social mobility and reinforces existing patterns of inequality.

Research demonstrates that digital skills often generate greater socioeconomic benefits than physical access alone. Individuals possessing strong digital competencies are more capable of utilizing online platforms for education, income generation, professional networking, and public service utilization. Consequently, investments in digital literacy and digital infrastructure play an important role in reducing social inequality, particularly in developing countries (Ragnedda & Ruiu, 2020).

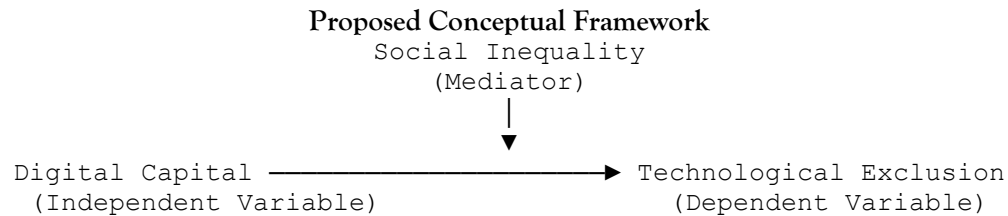
Digital Capital and Technological Exclusion

Digital capital is widely recognized as one of the strongest determinants of technological inclusion. Individuals with greater access to digital technologies and stronger digital competencies experience lower levels of technological exclusion because they can effectively participate in digital environments. Conversely, insufficient digital capital increases vulnerability to technological exclusion and reduces participation in digital education, e-commerce, telemedicine, online banking, and e-government services.

Recent empirical studies have demonstrated that expanding broadband infrastructure alone is insufficient to eliminate technological exclusion. Complementary investments in digital literacy, affordability, institutional support, and community training programs are equally important for promoting meaningful digital inclusion (van Dijk, 2020).

For rural Pakistan, strengthening digital capital through improved infrastructure, affordable internet services, digital education, and community-based technology initiatives represents a critical strategy for reducing technological exclusion and promoting sustainable rural development.

Conceptual Framework



Hypotheses

H1: Digital Capital has a significant negative effect on Technological Exclusion in rural communities of Pakistan.

H2: Digital Capital has a significant negative effect on Social Inequality.

H3: Social Inequality has a significant positive effect on Technological Exclusion.

H4: Social Inequality mediates the relationship between Digital Capital and Technological Exclusion.

Methodology

This study examined the relationship between Digital Capital, Social Inequality, and Technological Exclusion in rural communities of Pakistan. A quantitative research methodology was adopted to generate empirical evidence regarding the influence of digital capital on social inequality and technological exclusion among rural populations.

Research Design

A quantitative, cross-sectional survey research design was employed. The cross-sectional approach was considered appropriate because it enabled the collection of data from respondents at a single point in time and facilitated the examination of the proposed relationships among the study variables. The design also allowed the use of multivariate statistical techniques to test the hypothesized research model.

Population

The target population comprised adult residents of rural communities across Pakistan, including farmers, students, teachers, small business owners, community leaders, self-employed individuals, and government employees residing in rural districts.

These respondents were selected because they represented diverse socioeconomic backgrounds and varying levels of access to digital technologies, making them appropriate participants for assessing digital capital, social inequality, and technological exclusion.

Sampling Technique

A multistage stratified random sampling technique was employed. In the first stage, rural districts were selected from different provinces of Pakistan to ensure geographical representation. In the second stage, villages were randomly selected from each district. Finally, eligible respondents were randomly selected from the sampled villages. This approach enhanced the representativeness of the sample and minimized sampling bias.

Sample Size

A sample of 400 respondents was selected for the study. The sample size exceeded the minimum recommendations for Partial Least Squares Structural Equation Modeling (PLS-SEM) and was considered sufficient to provide adequate statistical power, reliable parameter estimates, and improved generalizability of the findings (Hair et al., 2022).

Data Collection Procedures

Primary data were collected using a structured, self-administered questionnaire adapted from previously validated scales reported in the literature on digital capital, digital inclusion, and social inequality.

Prior to the main survey, the questionnaire was reviewed by experts in information systems, rural development, sociology, and research methodology to ensure clarity, relevance, and content validity. A pilot study involving a small

group of rural respondents was conducted to refine the wording of the questionnaire and improve its reliability.

Following the pilot study, permission was obtained from relevant local authorities and community representatives. Data were collected through face-to-face administration of questionnaires by trained research assistants. Respondents were informed about the objectives of the study, assured of confidentiality and anonymity, and participation was entirely voluntary. Completed questionnaires were screened for completeness before coding and statistical analysis.

Instruments and Measures

Data were collected using a structured questionnaire consisting of four sections. All measurement items were adapted from previously validated instruments and assessed using a five-point Likert scale ranging from 1 = Strongly Disagree to 5 = Strongly Agree.

Digital Capital (Independent Variable)

Digital Capital was measured through items assessing respondents' access to digital devices, internet connectivity, affordability of digital technologies, digital literacy, online communication skills, information-search capabilities, and effective utilization of digital resources.

Social Inequality (Mediator)

Social Inequality was measured using indicators related to disparities in educational opportunities, employment, income, access to public services, social participation, and economic opportunities experienced by rural communities.

Technological Exclusion (Dependent Variable)

Technological Exclusion was measured through items assessing limited access to digital technologies, internet connectivity, digital services, online education, e-government services, digital financial services, and barriers to effective technology utilization.

Reliability and Validity

Reliability

Internal consistency reliability was evaluated using Cronbach's Alpha and Composite Reliability (CR). Values of 0.70 or above were considered acceptable, indicating satisfactory reliability of the measurement scales (Hair et al., 2022).

Validity

Content Validity

Content validity was established through expert evaluation involving specialists in information systems, sociology, rural development, and research methodology. Their recommendations were incorporated to improve the relevance, clarity, and comprehensiveness of the questionnaire.

Construct Validity

Construct validity was assessed using the measurement model in PLS-SEM. Standardized factor loadings of 0.70 or higher indicated that the observed indicators adequately represented their respective latent constructs.

Convergent Validity

Convergent validity was evaluated using the Average Variance Extracted (AVE). AVE values greater than 0.50 confirmed that each construct explained more than half of the variance of its measurement indicators.

Discriminant Validity

Discriminant validity was assessed using both the Fornell-Larcker Criterion and the Heterotrait-Monotrait Ratio (HTMT). HTMT values below 0.85 confirmed adequate discrimination among the study constructs.

Common Method Bias

To reduce common method bias, procedural remedies such as respondent anonymity, clear questionnaire wording, and randomization of questionnaire items were implemented. Harman's single-factor test was also performed to verify that common method variance did not significantly influence the results.

Data Analysis Technique

The collected data were coded, cleaned, and analyzed using the Statistical Package for the Social Sciences (SPSS) for descriptive statistics and preliminary analyses. SmartPLS 4 was employed to assess the measurement and structural models using Partial Least Squares Structural Equation

Modeling (PLS-SEM). The analysis included descriptive statistics, reliability assessment, validity testing, correlation analysis, hypothesis testing, mediation analysis, coefficient of determination (R^2), effect size (f^2), predictive relevance (Q^2), and model fit assessment.

Data Analysis

Respondents' Demographic Profile

Table 1: Demographic Characteristics of Respondents (N = 400)

Variable	Category	Frequency	Percentage (%)
Gender	Male	236	59.0
	Female	164	41.0
Age	18-30 Years	118	29.5
	31-45 Years	174	43.5
	Above 45 Years	108	27.0
Education	Primary	62	15.5
	Secondary	168	42.0
	Graduate	110	27.5
	Postgraduate	60	15.0
Internet Access	Yes	284	71.0
	No	116	29.0



The sample consisted of 400 rural respondents, with 59.0% males and 41.0% females. Most respondents (43.5%) were between 31 and 45 years of age. Approximately 42.0% had completed secondary education, while 71.0% reported

having internet access. The demographic profile indicates adequate diversity in age, education, and digital accessibility, making the sample appropriate for examining digital capital, social inequality, and technological exclusion

Descriptive Statistics

Table 2 : Descriptive Statistics

Construct	Mean	SD	Skewness	Kurtosis
Digital Capital	3.87	0.71	-0.36	-0.42
Social Inequality	3.61	0.75	0.29	-0.31
Technological Exclusion	3.79	0.69	0.25	-0.27

The descriptive statistics indicated that respondents reported a moderate level of digital capital ($M = 3.87$), while perceptions of social inequality ($M = 3.61$) and technological exclusion

($M = 3.79$) remained relatively high. The skewness and kurtosis values were within the acceptable range of ± 2 , confirming that the data approximated a normal distribution.

Reliability Analysis

Table 3 : Reliability Statistics

Construct	Cronbach's Alpha	Composite Reliability
Digital Capital	0.914	0.929
Social Inequality	0.901	0.918
Technological Exclusion	0.923	0.936

The reliability analysis demonstrated excellent internal consistency. Cronbach's Alpha values ranged from 0.901 to 0.923, while Composite Reliability values ranged from 0.918 to 0.936,

exceeding the recommended threshold of 0.70. These findings confirmed that all measurement scales were reliable.

Convergent Validity

Table 4 : Convergent Validity

Construct	Factor Loading Range	AVE
Digital Capital	0.75-0.91	0.70
Social Inequality	0.73-0.89	0.67
Technological Exclusion	0.77-0.92	0.72

All indicator loadings exceeded 0.70, and the AVE values ranged from 0.67 to 0.72, confirming satisfactory convergent validity. These results

indicate that the constructs adequately explained the variance of their measurement indicators.

Correlation Analysis

Table 5 : Correlation Matrix

Variable	1	2	3
Digital Capital	1		
Social Inequality	-0.591**	1	
Technological Exclusion	-0.674**	0.642**	1

Note. $p < .01$.

The correlation analysis revealed that Digital Capital was significantly and negatively associated with Social Inequality ($r = -0.591$, $p < .01$) and Technological Exclusion ($r = -0.674$, $p < .01$). In contrast, Social Inequality was positively associated with Technological Exclusion ($r =$

0.642 , $p < .01$). These findings suggest that greater digital capital is linked with lower levels of inequality and technological exclusion, whereas higher social inequality contributes to increased technological exclusion.

Structural Model Results

Table 6 : Hypothesis Testing

Hypothesis	Structural Path	β	t-value	p-value	Decision
H1	Digital Capital → Technological Exclusion	-0.482	10.84	<0.001	Supported
H2	Digital Capital → Social Inequality	-0.563	12.47	<0.001	Supported
H3	Social Inequality → Technological Exclusion	0.379	7.92	<0.001	Supported

The structural model demonstrated that Digital Capital had a significant negative effect on Technological Exclusion ($\beta = -0.482$, $p < .001$), supporting H1. Digital Capital also exerted a significant negative influence on Social Inequality ($\beta = -0.563$, $p < .001$), supporting H2.

Furthermore, Social Inequality had a significant positive effect on Technological Exclusion ($\beta = 0.379$, $p < .001$), confirming H3. These findings indicate that improving digital capital can simultaneously reduce social inequality and technological exclusion in rural communities.

Mediation Analysis

Table 7 : Indirect Effect

Hypothesis Indirect Path	β	t-value	p-value	Decision
H4 Digital Capital → Social Inequality → Technological Exclusion	-0.213	5.81	<0.001	Supported

The mediation analysis confirmed that Social Inequality significantly mediated the relationship between Digital Capital and Technological Exclusion ($\beta = -0.213$, $p < .001$). This finding

indicates that increasing digital capital reduces technological exclusion both directly and indirectly by alleviating social inequality.

Coefficient of Determination (R^2)

Table 8 : Coefficient of Determination

Endogenous Variable	R^2	Interpretation
Social Inequality	0.317	Moderate
Technological Exclusion	0.564	Substantial

The R^2 values indicate that Digital Capital explained 31.7% of the variance in Social Inequality, while Digital Capital and Social Inequality jointly explained 56.4% of the variance

in Technological Exclusion. These findings demonstrate that the proposed model possesses moderate to substantial explanatory power.

Summary of Hypotheses

Table 9 : Summary of Hypothesis Testing

Hypothesis	Statement	Result
H1	Digital Capital negatively affects Technological Exclusion.	Supported
H2	Digital Capital negatively affects Social Inequality.	Supported
H3	Social Inequality positively affects Technological Exclusion.	Supported
H4	Social Inequality mediates the relationship between Digital Capital and Technological Exclusion.	Supported

The findings demonstrate that Digital Capital plays a pivotal role in reducing Technological Exclusion and Social Inequality in rural communities of Pakistan. Individuals with greater access to digital technologies, reliable internet connectivity, and stronger digital skills were less likely to experience exclusion from digital services and opportunities. Moreover, Social Inequality emerged as a significant mediator, indicating that inadequate digital capital reinforces socioeconomic disparities, which in turn increase technological exclusion. Overall, the findings support Digital Capital Theory, suggesting that strengthening digital infrastructure, improving digital literacy, and ensuring equitable access to technology are essential for narrowing the rural digital divide, promoting social inclusion, and advancing sustainable socioeconomic development in Pakistan.

Discussion

The findings of this study demonstrated that Digital Capital plays a significant role in reducing Social Inequality and Technological Exclusion in rural communities of Pakistan. The results indicated that individuals possessing greater access to digital technologies, internet connectivity, digital devices, and digital competencies experienced substantially lower levels of technological exclusion. These findings support Digital Capital Theory, which argues that digital resources and digital skills function as valuable forms of capital that enhance individuals' ability to participate in education, employment, public services, and the digital economy (Ragnedda, 2018; Ragnedda & Ruiu, 2020).

The study found a significant negative relationship between Digital Capital and Technological Exclusion, suggesting that improved digital access and digital literacy reduce barriers to technology utilization. This finding is consistent with previous studies indicating that meaningful digital inclusion requires not only internet access but also the knowledge and skills necessary to effectively use digital technologies (van Dijk, 2020). For rural Pakistan, expanding broadband infrastructure, improving affordability, and strengthening digital literacy programs are likely to reduce technological exclusion and promote greater participation in digital services.

The findings also revealed that Digital Capital significantly reduced Social Inequality. Rural residents with higher levels of digital capital were better able to access online education, employment opportunities, financial services, agricultural information, and e-government services, thereby improving their socioeconomic opportunities. This finding supports previous research suggesting that digital technologies can enhance social mobility when individuals possess sufficient digital capabilities (van Deursen & Helsper, 2015).

Furthermore, the study confirmed that Social Inequality positively influenced Technological Exclusion, indicating that economically and socially disadvantaged individuals are more likely to experience barriers to digital participation. Limited education, lower income, inadequate infrastructure, and restricted institutional support collectively increase technological exclusion among rural populations. These findings are consistent with international evidence demonstrating that socioeconomic inequality

remains a major determinant of digital exclusion (International Telecommunication Union [ITU], 2023).

The mediation analysis further demonstrated that Social Inequality partially mediated the relationship between Digital Capital and Technological Exclusion. This finding suggests that strengthening digital capital not only directly improves digital inclusion but also indirectly reduces technological exclusion by alleviating socioeconomic inequalities. Consequently, investments in digital infrastructure, affordable internet services, and digital skills development can simultaneously promote social inclusion and sustainable rural development.

Conclusion

This study investigated the relationship between Digital Capital, Social Inequality, and Technological Exclusion in rural communities of Pakistan. The findings confirmed that digital capital is a critical determinant of digital inclusion and socioeconomic participation. Individuals with greater access to digital technologies and stronger digital competencies experienced significantly lower levels of technological exclusion and social inequality.

The study also established that social inequality significantly contributes to technological exclusion and mediates the relationship between digital capital and technological exclusion. These findings emphasize that improving digital infrastructure alone is insufficient unless accompanied by initiatives that enhance digital literacy, affordability, education, and equitable access to technology.

Overall, the study concludes that strengthening digital capital represents an effective strategy for reducing the rural digital divide, promoting social inclusion, improving access to digital services, and supporting sustainable socioeconomic development in Pakistan.

Implications

Theoretical Implications

The study contributes to the literature by extending Digital Capital Theory within the

context of rural Pakistan. It empirically demonstrates that digital capital influences technological exclusion both directly and indirectly through social inequality. The findings provide an integrated conceptual framework for understanding digital inclusion in developing countries and enrich research on the relationship between digital resources and socioeconomic development.

Practical Implications

The findings provide valuable guidance for educators, rural development practitioners, telecommunications providers, and community organizations. Expanding digital literacy programs, improving access to affordable digital devices, and strengthening community-based technology centers can substantially enhance digital participation among rural populations. Educational institutions and non-governmental organizations can also use the findings to design targeted interventions that improve digital competencies and reduce technological exclusion.

Policy Implications

The findings offer important evidence for policymakers responsible for digital transformation, telecommunications, education, and rural development. Government agencies should prioritize investments in broadband infrastructure, affordable internet access, rural connectivity, digital literacy initiatives, and inclusive digital policies. Strengthening collaboration among government institutions, private-sector organizations, and development partners will be essential for achieving equitable digital development and narrowing the urban-rural digital divide.

Recommendations

Based on the findings, the following recommendations are proposed:

- The Government of Pakistan should expand high-speed broadband infrastructure and improve internet coverage in underserved rural communities.

- Affordable internet packages and subsidized digital devices should be introduced to increase digital accessibility for low-income households.
- Comprehensive digital literacy and digital skills training programs should be implemented through schools, universities, vocational institutions, and community centers.
- Public-private partnerships should be strengthened to accelerate rural digital transformation and expand access to digital services.
- Special initiatives should be introduced to reduce gender-based digital inequalities by increasing women's access to digital technologies and digital education.
- Government agencies should enhance the availability and accessibility of e-government, digital health, digital education, and digital financial services for rural populations.
- Continuous monitoring and evaluation mechanisms should be established to assess the effectiveness of digital inclusion policies and identify emerging challenges.

Limitations and Future Directions

This study has several limitations. First, the use of a cross-sectional research design limited the ability to establish causal relationships among digital capital, social inequality, and technological exclusion over time. Future studies should employ longitudinal research designs to examine changes in digital inclusion across different stages of technological development.

Second, the study relied on self-reported survey data, which may be subject to respondent bias and common method variance. Future research should integrate survey data with qualitative interviews, case studies, and administrative data to obtain a more comprehensive understanding of digital inclusion.

Third, the study focused exclusively on rural communities in Pakistan, limiting the generalizability of the findings to urban areas or other developing countries. Comparative studies across different regions and countries would enhance external validity.

Fourth, only social inequality was examined as a mediating variable. Future studies should investigate additional mediators and moderators such as digital literacy, technology readiness, digital self-efficacy, government support, socioeconomic status, gender, educational attainment, and digital trust.

Finally, future research should explore the long-term impacts of emerging technologies, including artificial intelligence, 5G connectivity, digital financial services, smart agriculture, e-health, and digital governance, on digital inclusion and sustainable rural development in Pakistan.

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