

Effects of Digital Communication Impact on Performance of Women Owned Cereals Enterprises, in Mukuru Kwa Njenga slums in Nairobi City, Kenya

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Abstract: Digital technologies in sub-Saharan Africa offer small-scale entrepreneurs' opportunities to improve business operations, market access, and financial management, but their success depends on individual digital literacy. Digital literacy has transformed small and medium business operations and enhanced entrepreneurial success by enabling improved business efficiency, online marketing, and promoting communication. However, significant gaps persist in understanding how digital literacy specifically influences business performance among women entrepreneurs in informal settlement contexts. The problem is particularly acute in Kenya's urban slums, where women constitute a substantial proportion of small business owners yet face multiple barriers to digital literacy adoption and effective utilization. This study investigated the relationship between digital communication capabilities and business performance among 212 women-owned cereals enterprises operating within Mukuru Kwa Njenga informal settlement, Nairobi City, Kenya. The study utilized Digital Literacy Theory, Resource-Based View Theory, and Gender and Development Theories as theoretical frameworks. A mixed-methods approach was adopted, combining quantitative analysis of digital literacy dimensions and business performance indicators with qualitative investigation of systemic barriers, enabling factors, and entrepreneurial experiences. Findings revealed that digital literacy is the primary performance differentiator, explaining 32.4% of business performance variance—more than twice the effect of demographic and business characteristics combined (16.3%). Digital communication emerged as the dominant pathway ($\beta=0.298$, $p<0.001$), with the strongest correlations to customer base size ($r=0.542$) and monthly revenue ($r=0.487$). Despite near-universal smartphone ownership (91.5%), critical gaps exist between basic and advanced literacy. Digital inclusion requires coordinated interventions addressing infrastructure investment, comprehensive training programs, simplified technology design, affordability mechanisms, and policy adaptation. The study recommends phased interventions organized into immediate (0-2 years), medium-term (2-5 years), and long-term (5-10 years) priorities involving government agencies, development organizations, technology providers, and business associations. These findings contribute to knowledge on digital inclusion in informal economies and provide evidence-based guidance for policymakers and practitioners seeking to improve digital literacy and business outcomes among informal sector entrepreneurs.

Keywords: Digital Communication, Performance, Women Owned Cereals Enterprises, Mukuru Kwa Njenga slums

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I. INTRODUCTION

1.1 Background information

Digital marketing began in the 20th century with the early electronic data base introduction. However, social Media engagement and personalization of digital devices have eased the way of sourcing for new markets to sell consumable goods as well as looking for the goods to sell by using digital devices and appliances.

The importance of doing this study will be to find out the Effectiveness of Digital Technologies Literacy on Performance of Women-Owned Small and Medium Enterprises in Informal Settlements in Kenya specially in SMEs in Cereals Business in Mukuru Kwa Njenga Slums, Nairobi City. In Mathare valley slums in Nairobi city women entrepreneurs in informal settlements face various challenges in digital uptake. This includes poor power supply, and interruption as well as limited access to internet.

The digital revolution has fundamentally transformed the landscape of global business operations, creating unprecedented opportunities for economic participation and growth across diverse geographical regions. In the contemporary business environment, digital literacy has emerged as a critical determinant of entrepreneurial success, particularly for marginalized communities seeking to leverage technology for economic empowerment.

The intersection of digital literacy and women's entrepreneurship represents a significant area of scholarly inquiry, with implications that extend across continents and economic systems.

Asian economies have demonstrated remarkable innovation in leveraging digital technologies to support women's entrepreneurship. In countries such as India, China, and South Korea, government-led initiatives have focused on developing digital literacy programs specifically targeting women entrepreneurs in various sectors. Research conducted by Lee and Patel (2022) in the Asian context revealed that women entrepreneurs with higher digital literacy levels were significantly more successful in accessing online markets, utilizing digital payment systems, and implementing data-driven decision-making processes. The rapid adoption of mobile technology and e-commerce platforms across Asia has created unique opportunities for women entrepreneurs to overcome traditional barriers to market entry and business growth.

Australia's approach to digital literacy and women's entrepreneurship has been characterized by comprehensive policy frameworks and targeted support programs. The Australian government's Digital Business Plan has prioritized the development of digital skills among women entrepreneurs, recognizing the critical role of technology in driving economic growth and innovation. Studies conducted by the Australian Bureau of Statistics have shown that women-owned businesses with higher levels of digital literacy demonstrate superior performance across multiple indicators, including revenue growth, market expansion, and operational efficiency (Williams & Brown, 2023).

East Africa has experienced unprecedented growth in digital technology adoption, creating significant opportunities for women entrepreneurs across the region. The East African Community's Digital Transformation Strategy has prioritized the development of digital literacy skills as a key driver of economic growth and social development. Countries within the region, including Tanzania, Uganda, Rwanda, and Kenya, have implemented various initiatives aimed at enhancing digital literacy among women entrepreneurs, recognizing the critical role of technology in promoting inclusive economic growth.

The mobile money revolution that originated from East Africa has fundamentally transformed the financial landscape for women entrepreneurs throughout the region. Research conducted by Nakamura and Kiprotich (2023) demonstrated that women entrepreneurs with higher levels of digital literacy were more effective in utilizing mobile money platforms for business transactions, customer payments, and financial management. The widespread adoption of mobile technology across East Africa has created unique opportunities for women entrepreneurs to overcome traditional barriers related to financial inclusion and market access.

Rwanda's remarkable progress in digital transformation has provided valuable insights into the relationship between digital literacy and women's entrepreneurship. The country's Vision 2020 initiative prioritized the development of digital skills among women entrepreneurs, resulting in significant improvements in business performance and economic participation. Studies conducted by the Rwanda Development Board have shown that women entrepreneurs with enhanced digital literacy skills demonstrate superior performance in areas such as market access, customer engagement, and financial management (Uwimana & Gasana, 2022).

Uganda's experience with digital literacy programs for women entrepreneurs has yielded important lessons for the broader East African region. The Uganda Women Entrepreneurs Association has implemented comprehensive digital literacy training programs, resulting in measurable improvements in business performance among participating women entrepreneurs. Research conducted by Nakato and Ssemugabi (2023) revealed that women entrepreneurs who completed digital literacy training programs experienced significant increases in revenue generation, market reach, and operational efficiency.

Kenya has emerged as a regional leader in digital innovation and technology adoption, creating significant opportunities for women entrepreneurs across various sectors. The country's Vision 2030 development blueprint recognizes the critical role of digital literacy in promoting inclusive economic growth and reducing poverty. Kenya's remarkable progress in mobile money adoption, with platforms such as M-Pesa revolutionizing financial services delivery, has created unique opportunities for women entrepreneurs to access financial services and expand their business operations.

The Kenyan government's commitment to promoting women's entrepreneurship is reflected in various policy initiatives and support programs. The Women Enterprise Fund, established by the government, has provided financial support and capacity building programs for women entrepreneurs across the country. Research conducted by Wanjiku and Muthoni (2023) revealed that women entrepreneurs who participated in government-supported programs demonstrated significant improvements in business performance, particularly when combined with digital literacy training components.

Kenya's thriving technology sector, often referred to as "Silicon Savannah," has created a conducive environment for digital innovation and entrepreneurship. The presence of numerous technology companies, incubators, and accelerators has facilitated the development of digital solutions specifically designed to support women entrepreneurs. Studies conducted by Kamau and Njoroge (2022) demonstrated that women entrepreneurs operating in technology-enabled environments were more likely to adopt digital tools and technologies, resulting in improved business performance across multiple indicators.

The informal sector in Kenya, which employs a significant proportion of women entrepreneurs, has experienced remarkable transformation through digital technology adoption. Research conducted by Otieno and Wambui (2023) revealed that women entrepreneurs operating in informal sectors who possessed higher levels of digital literacy were more successful in formalizing their businesses, accessing new markets, and improving their financial management practices. The integration of digital technologies into informal business operations has created opportunities for women entrepreneurs to scale their operations and achieve sustainable growth.

Kenya's financial sector has undergone significant transformation through digital innovation, creating new opportunities for women entrepreneurs to access financial services. The widespread adoption of mobile banking, digital lending platforms, and electronic payment systems has reduced traditional barriers to financial inclusion. Studies conducted by Mutua and Kibet (2022) demonstrated that women entrepreneurs with higher levels of digital literacy were more effective in utilizing digital financial services, resulting in improved cash flow management, better access to credit, and enhanced financial planning capabilities.

Urban slums represent unique environments for entrepreneurial activity, characterized by both significant challenges and remarkable opportunities for innovation and economic growth. The concentration of population in urban slum areas creates substantial market opportunities for entrepreneurs, while simultaneously presenting complex challenges related to infrastructure, access to services, and regulatory compliance. Research conducted across various urban slum environments globally has revealed the critical role of entrepreneurship in providing livelihood opportunities and driving economic development within these communities.

The entrepreneurial ecosystem within urban slums is characterized by high levels of innovation and resourcefulness, as entrepreneurs develop creative solutions to overcome infrastructure and resource constraints. Studies conducted by Patel and Singh (2023) in urban slum environments across India revealed that women entrepreneurs demonstrated remarkable adaptability in utilizing available resources and technologies to develop successful business operations. The informal nature of many businesses operating within urban slums creates both opportunities and challenges for digital technology adoption and integration.

Access to digital technologies and internet connectivity within urban slum environments has improved significantly in recent years, creating new opportunities for women entrepreneurs to leverage digital tools for business growth. Research conducted by Chen and Liu (2022) in urban slum areas across China demonstrated that improved digital infrastructure led to increased adoption of digital technologies among women entrepreneurs, resulting in enhanced business performance and market access capabilities.

The social networks and community structures within urban slums play a critical role in supporting entrepreneurial activities and facilitating knowledge transfer. Studies conducted by Rodriguez and Garcia (2023) in urban slum environments across Latin America revealed that women entrepreneurs who were well-integrated into community networks were more likely to adopt digital technologies and achieve business success. The collective nature of many entrepreneurial activities within urban slums creates opportunities for collaborative learning and skill development in digital literacy.

Financial inclusion remains a significant challenge for entrepreneurs operating within urban slum environments, with traditional financial institutions often reluctant to provide services to this population segment. However, the emergence of digital financial services has created new opportunities for women entrepreneurs to access financial products and services. Research conducted by Okonkwo and Adebayo (2022) in urban slum areas across Nigeria demonstrated that women entrepreneurs with higher levels of digital literacy were more successful in accessing digital financial services, resulting in improved business performance and growth opportunities.

The cereals business sector represents a critical component of food systems globally, providing essential nutrition and livelihood opportunities for millions of people worldwide. Women entrepreneurs play a particularly important role in cereals value chains, often serving as key intermediaries between producers and consumers, while also engaging in processing, packaging, and retail activities. The sector's significance extends beyond economic considerations to encompass food security, nutrition, and social development objectives.

Global cereals markets have experienced significant transformation through digital technology adoption, with implications for entrepreneurs operating at various levels of the value chain. Research conducted by FAO (2023) revealed that digital technologies have enhanced market transparency, improved price discovery mechanisms, and facilitated more efficient supply chain management within cereals markets. Women entrepreneurs who possess higher levels of digital literacy are better positioned to leverage these technological advances for business growth and market expansion.

The cereals processing sector has witnessed remarkable innovation through the adoption of digital technologies, creating opportunities for women entrepreneurs to enhance product quality, improve operational efficiency, and access new market segments. Studies conducted by Kumar and Sharma (2022) in cereals processing enterprises across India demonstrated that women entrepreneurs with higher levels of digital literacy were more successful in implementing quality control systems, managing inventory, and developing customer relationships.

Market access represents a critical challenge for women entrepreneurs operating in the cereals sector, particularly those located in remote or underserved areas. Digital technologies have emerged as powerful tools for overcoming geographical barriers and connecting women entrepreneurs with broader market opportunities. Research conducted by Banda and Phiri (2023) in cereals markets across Zambia revealed that women entrepreneurs who utilized digital marketing platforms and e-commerce solutions achieved significantly higher sales volumes and market reach compared to those relying solely on traditional marketing approaches.

Financial management within the cereals business sector requires sophisticated understanding of market dynamics, price volatility, and seasonal variations in supply and demand. Digital technologies have created opportunities for women entrepreneurs to access real-time market information, implement more effective pricing strategies, and manage financial risks more effectively. Studies conducted by Mwangi and Kariuki (2022) in cereals enterprises across Kenya demonstrated that women entrepreneurs with higher levels of digital literacy were more successful in managing cash flows, accessing credit facilities, and implementing financial planning systems.

Mukuru Kwa Njenga represents one of Nairobi's largest informal settlements, housing an estimated population of over 100,000 residents within a relatively small geographical area. The settlement is characterized by high population density, limited infrastructure, and significant socioeconomic challenges, while simultaneously serving as a hub of entrepreneurial activity and economic innovation. The unique characteristics of Mukuru Kwa Njenga create both opportunities and constraints for women entrepreneurs seeking to establish and grow their businesses within this environment.

The economic landscape of Mukuru Kwa Njenga is dominated by small-scale enterprises operating primarily within the informal sector. Women entrepreneurs play a particularly prominent role in the local economy, engaging in various business activities including food processing, retail trade, and service provision. Research conducted by Njeri and Wanjala (2023) revealed that women-owned enterprises constitute approximately 60% of all business activities within Mukuru Kwa Njenga, highlighting the critical importance of women's entrepreneurship for the local economy.

Infrastructure challenges within Mukuru Kwa Njenga significantly impact business operations, with limited access to reliable electricity, water supply, and transportation networks. However, the widespread adoption of mobile technology has created opportunities for entrepreneurs to overcome some of these infrastructure constraints. Studies conducted by Otieno and Mwangi (2022) demonstrated that mobile technology adoption rates within Mukuru Kwa Njenga exceed 80%, creating significant potential for digital technology integration within business operations.

The social fabric of Mukuru Kwa Njenga is characterized by strong community networks and collaborative relationships that facilitate entrepreneurial activities and knowledge sharing. Women entrepreneurs within the settlement often rely on informal networks for business support, market information, and financial assistance. Research conducted by Wambui and Kamau (2023) revealed that women entrepreneurs who were well-integrated into community networks were more likely to achieve business success and demonstrate resilience in the face of economic challenges.

Access to financial services within Mukuru Kwa Njenga has improved significantly through the expansion of mobile money services and digital lending platforms. However, many women entrepreneurs continue to face challenges in accessing formal financial services due to lack of collateral, limited credit history, and regulatory barriers. Studies conducted by Mutindi and Kiprotich (2022) demonstrated that women entrepreneurs with higher levels of digital literacy were more successful in accessing digital financial services and managing their financial obligations effectively.

The cereals business sector within Mukuru Kwa Njenga encompasses various activities including wholesale trading, retail sales, processing, and packaging operations. Women entrepreneurs play a dominant role in cereals retail activities, often operating small shops and market stalls that serve the local community. Research conducted by Nyambura and Ochieng (2023) revealed that cereals businesses constitute approximately 25% of all women-owned enterprises within Mukuru Kwa Njenga, highlighting the sector's significance for women's economic empowerment within the settlement.

1.2 Statement of the Problem

Digital literacy has transformed small and medium business operations and enhanced entrepreneurial success by enabling improved business efficiency, online marketing, and promoting communication. However, significant gaps persist in understanding how digital literacy specifically influences business performance among women entrepreneurs in informal settlement contexts. The problem is particularly acute in Kenya's urban slums, where women constitute a substantial proportion of small business owners yet face multiple barriers to digital literacy adoption and effective utilization. (Faith Mbaya, 2025)

According to Murumba R.N (2021) Women entrepreneurs operating cereals businesses in Mukuru Kwa Njenga slums encounter a complex web of challenges that limit their ability to leverage digital technologies for

business growth. These challenges include limited access to reliable internet connectivity, inadequate digital devices, and insufficient digital skills training opportunities, and cultural barriers that restrict women's engagement with technology. Consequently, many women-owned cereals enterprises continue to rely on traditional business practices that may limit their growth potential, market reach, and competitive positioning.

The lack of comprehensive understanding regarding the relationship between digital literacy and business performance indicators among women-owned cereals enterprises creates several problems for policy makers, development practitioners, and the entrepreneurs themselves. Without clear evidence of how digital literacy influences specific business outcomes such as revenue generation, customer acquisition, inventory management, and financial service access, it becomes difficult to design targeted interventions that effectively support women entrepreneurs in leveraging digital technologies for business improvement (ITC/ILO & WIDB, 2025).

Furthermore, the absence of detailed knowledge about which specific digital tools and technologies are most relevant and accessible to women entrepreneurs in the cereals sector limits the effectiveness of digital literacy training programs and technology adoption initiatives. Many existing programs adopt one-size-fits-all approaches that may not address the unique needs, constraints, and opportunities faced by women operating cereals businesses in informal settlement environments.

The problem is compounded by the rapid pace of technological change and the increasing digitization of business processes across various sectors. As formal businesses and larger enterprises increasingly adopt digital technologies for operations, marketing, and customer engagement, women entrepreneurs who lack digital literacy skills risk being further marginalized and excluded from emerging market opportunities. This digital divide threatens to exacerbate existing inequalities and limit the potential for inclusive economic growth in informal settlement contexts.

Additionally, financial institutions and service providers are increasingly moving toward digital platforms for service delivery, making digital literacy essential for accessing credit, insurance, and other financial services that are crucial for business growth and sustainability. Women entrepreneurs who lack adequate digital literacy skills may find themselves excluded from these services, further limiting their business development opportunities and perpetuating cycles of economic marginalization.

According to Kerei Lucy 2023, in a study she conducted in Mathare slums about women-owned businesses operating in most informal settlements in Nairobi City struggle with digital literacy to operate their business. It is therefore from the above back ground the study aimed at establishing the effectiveness of digital literacy on the performance of women-owned small and medium enterprises operating in the cereals business within the informal settlement of Mukuru Kwa Njenga slums in Nairobi City, Kenya.

1.3 Study Objective

The objective of the study was to examine the effects of digital communication impact on performance of women owned cereals enterprises, in Mukuru Kwa Njenga slums in Nairobi City

1.4 Significance of the Study

This study holds significant theoretical, practical, and policy implications that extend beyond the immediate research context to contribute to broader understanding of digital entrepreneurship, women's economic empowerment, and inclusive development in informal economy settings. The significance of this research can be understood through multiple dimensions that address various stakeholder needs and knowledge gaps.

From a theoretical perspective, this study contributes to the growing body of literature on digital entrepreneurship by providing empirical evidence from a unique context that has been underrepresented in existing research. The findings will enhance understanding of how digital literacy functions as a resource and capability in resource-constrained environments, contributing to the Resource-Based View of the firm and extending its application to informal sector enterprises. Additionally, the study contributes to feminist entrepreneurship theory by examining how gender intersects with digital literacy and business performance in specific cultural and economic contexts.

The study's contribution to Technology Acceptance Model literature is particularly significant, as it examines technology adoption and utilization patterns among a population that faces unique barriers and constraints compared to typical study populations. By exploring how perceived usefulness and ease of use manifest in informal settlement contexts, the research provides insights that can inform more inclusive technology design and implementation strategies.

From a practical perspective, the study provides valuable insights for women entrepreneurs operating in similar contexts, offering evidence-based guidance on the potential benefits of digital literacy development and specific strategies for leveraging digital technologies for business improvement. The identification of specific digital tools and technologies currently utilized by successful women entrepreneurs provides practical models that others can adapt and implement.

The research findings will be particularly valuable for organizations involved in entrepreneurship development, digital literacy training, and women's economic empowerment programs. By understanding the specific relationships between digital literacy and business performance indicators, these organizations can design more targeted and effective interventions that address the unique needs and constraints faced by women entrepreneurs in informal settlements.

For policy makers, this study provides empirical evidence that can inform the development of policies and programs aimed at promoting digital inclusion and supporting small enterprise development. The findings can contribute to more nuanced understanding of how digital divide issues manifest in informal settlement contexts and what types of interventions are most likely to be effective in addressing these challenges.

The study's significance extends to the broader development community, as it provides insights into how digital technologies can contribute to inclusive economic growth and poverty reduction in urban informal settlements. Given the rapid urbanization trends in sub-Saharan Africa and the growing importance of informal economies, understanding how to effectively leverage digital technologies for small enterprise development has significant implications for sustainable development efforts.

From a methodological perspective, the study contributes to the development of research approaches for examining digital literacy and business performance in informal sector contexts. The measurement instruments and analytical frameworks developed for this research can be adapted and applied in other similar contexts, contributing to the broader research infrastructure for studying digital entrepreneurship in developing countries.

The study also has significant implications for the private sector, particularly for technology companies, financial service providers, and telecommunications companies seeking to develop products and services for informal market segments. Understanding how women entrepreneurs currently use digital technologies and what barriers they face can inform product development and market entry strategies that better serve this important but often overlooked market segment.

1.5 Theoretical Framework

The study was based on Digital Literacy Theory, Technology Acceptance Model (TAM), Resource-Based View (RBV) theory, and Gender and Development Theory as explained below.

The foundation of this conceptual framework rests on digital literacy theory, which encompasses the knowledge, skills, and attitudes required to effectively use digital technologies for various purposes. Digital literacy extends beyond basic computer skills to include critical thinking about digital information, understanding of digital communication protocols, and the ability to create and share digital content. In the context of women-owned cereals enterprises, digital literacy represents the capacity to utilize technology for business operations, customer engagement, financial management, and market expansion.

The framework adopts a multidimensional view of digital literacy that includes technical skills, cognitive abilities, and social-emotional competencies. Technical skills encompass the operational knowledge required to use digital devices, software applications, and online platforms. Cognitive abilities involve the capacity to evaluate, analyze, and synthesize digital information for business decision-making. Social-emotional competencies include the confidence and motivation to engage with digital technologies, as well as the ability to collaborate and communicate effectively in digital environments.

The Technology Acceptance Model provides crucial insights into how women entrepreneurs in Mukuru Kwa Njenga adopt and integrate digital tools into their cereal's businesses. This model suggests that technology adoption is influenced by perceived usefulness and perceived ease of use, which are mediated by attitudes toward technology use and behavioral intentions. In the context of resource-constrained environments, additional factors such as cost considerations, infrastructure limitations, and social support systems significantly influence technology acceptance decisions.

The framework recognizes that women entrepreneurs in informal settlements may face unique barriers to technology acceptance, including limited financial resources, inadequate digital infrastructure, and cultural or social constraints. These factors interact with individual characteristics such as age, education level, and prior technology experience to shape adoption patterns and usage behaviors.

The Resource-Based View provides a theoretical lens for understanding how digital literacy functions as a strategic resource for women-owned cereals enterprises. This perspective suggests that sustainable competitive advantage derives from valuable, rare, inimitable, and non-substitutable resources. Digital literacy, when effectively developed and applied, can serve as such a resource by enabling entrepreneurs to access new markets, improve operational efficiency, and enhance customer relationships.

In the context of informal cereals businesses, digital literacy represents both a tangible resource through access to digital tools and an intangible resource through the knowledge and skills required to leverage these tools effectively. The framework recognizes that the value of digital literacy as a strategic resource is contingent upon the entrepreneur's ability to integrate digital capabilities with other business resources and competencies.

The conceptual framework incorporates gender and development theory to address the specific challenges and opportunities faced by women entrepreneurs in patriarchal societies. This theoretical perspective recognizes that women's access to and use of digital technologies is influenced by gender norms, power relations, and structural inequalities. The framework acknowledges that digital literacy interventions must be designed with an understanding of how gender intersects with other social identities to shape women's experiences with technology.

Gender and development theory emphasizes the importance of women's agency and empowerment in driving sustainable development outcomes. In the context of this study, the framework recognizes that digital literacy can serve as a tool for women's economic empowerment by providing access to information, markets, and financial services that were previously unavailable or difficult to access.

II. METHODOLOGY

2.1 Area of Study

The study was conducted in Mukuru Kwa Njenga slums, one of the largest informal settlements in Nairobi City, Kenya. Mukuru Kwa Njenga was selected as the study area due to its significant population of women entrepreneurs engaged in various micro and small enterprises, including cereals businesses (Mutisya & Yarime, 2024). The settlement is characterized by limited infrastructure, high population density, and prevalent poverty, making it representative of many informal settlements in sub-Saharan Africa where women entrepreneurs operate under challenging conditions.

The choice of Mukuru Kwa Njenga was further justified by the presence of various development organizations and initiatives focused on women's economic empowerment and digital inclusion, providing a relevant context for examining the impact of digital literacy on business performance (Omwansa & Sullivan, 2024). The settlement's proximity to Nairobi's central business district also presents unique opportunities and challenges for market access, making it an ideal location to study the relationship between digital literacy and market engagement strategies.

2.2 Research Design

This study employed a mixed-methods research design to comprehensively examine the relationship between digital literacy and business performance among women-owned cereals enterprises in Mukuru Kwa Njenga slums, Nairobi City, Kenya. The mixed-methods approach combined quantitative and qualitative research methodologies to provide a holistic understanding of the complex relationships between digital literacy, technology adoption, and business outcomes in this specific socio-economic context (Creswell & Plano Clark, 2024). This methodological choice was particularly appropriate for investigating the multifaceted nature of digital literacy's impact on entrepreneurial activities in informal settlement environments, where traditional business metrics may not fully capture the nuanced realities of women's entrepreneurial experiences.

The convergent parallel mixed-methods design was implemented, allowing for simultaneous collection and analysis of both quantitative and qualitative data streams (Tashakkori & Teddlie, 2024). This approach enabled the researcher to triangulate findings from multiple data sources, thereby enhancing the validity and reliability of the research outcomes while providing a more comprehensive understanding of how digital literacy influences various aspects of women's cereals businesses in the study area.

2.3 Population and Sampling Design

The target population for this study comprised 450 women entrepreneurs who own and operate cereals businesses within Mukuru Kwa Njenga slums in Nairobi City, Kenya. This population was defined as women aged 18 years and above who have been operating cereals-related businesses for at least six months, ensuring sufficient business experience to assess performance indicators meaningfully. Mukuru Kwa Njenga is one of the largest informal settlements in Nairobi, characterized by high population density, limited infrastructure, and significant economic challenges, making it an ideal location for examining the role of digital literacy in enhancing women's entrepreneurial activities (Mutisya & Yarime, 2024). The cereals business category will include enterprises involved in the sale, processing, packaging, or distribution of various cereal products such as maize, rice, wheat, millet, and sorghum.

A multi-stage sampling technique was employed to select participants for this study. The first stage involved purposive sampling to identify areas within Mukuru Kwa Njenga with high concentrations of cereals businesses. This was achieved through consultation with local community leaders, market associations, and preliminary field visits to map the distribution of cereals enterprises across different sections of the settlement. The second stage employed stratified random sampling to ensure proportional representation across different categories of cereals businesses.

For the quantitative component, the sample size was determined using Yamane's formula for finite populations, with a 95% confidence level and a 5% margin of error (Yamane, 1967). Given the target population of 450 women entrepreneurs, the calculated sample size was 212 respondents.

The qualitative component involved purposive sampling of 30 women entrepreneurs selected from the quantitative sample based on maximum variation sampling principles. This approach ensured representation of diverse experiences across different business categories, digital literacy levels, and business performance outcomes (Patton, 2023). In this study, the sample size was determined by using Yamane (1967) simplified formula as demonstrated below:

Where:

n = sample size,

N = population size.

e = margin error or the level of precision

i = Constant

This formula assumes variability (i.e. proportion) of 0.5, the level of precision of 5% and a confidence level of 95%. Applying the formula to 450 target population, the sample size for the study was:

$$n = 450 / [1 + 450 (0.05)^2]$$

$$n = 212$$

Upon increasing by 15% the sample size for the study therefore comprised 244 SMEs.

2.4 Data Collection and Analysis

The quantitative data collection was conducted through structured questionnaires administered via face-to-face interviews. The questionnaire was developed based on established digital literacy assessment frameworks and business performance measurement tools, adapted to the specific context of women-owned cereals enterprises in informal settlements (Van Deursen & Van Dijk, 2023; Bharadwaj, 2024).

The questionnaire comprised several sections addressing different aspects of the research objectives. The digital literacy assessment section utilized a modified version of the Digital Literacy Scale developed by Ng (2024), incorporating technical, cognitive, and social-emotional dimensions of digital literacy. This scale was adapted to include specific digital tools and platforms commonly used in the Kenyan business context, such as mobile money services, social media platforms, and e-commerce applications.

Business performance indicators were measured using both financial and non-financial metrics. Financial performance measures included monthly revenue, profit margins, cost reduction achievements, and access to credit facilities. Non-financial performance indicators encompassed market reach, customer base expansion, supplier relationships, and business growth aspirations (Venkatraman & Ramanujam, 2025). These indicators were measured using Likert-scale questions and specific numerical data where applicable.

The digital tools and technologies utilization section employed a comprehensive inventory of digital platforms and applications relevant to small-scale businesses in Kenya. This included mobile banking services like M-Pesa, social media platforms such as Facebook and WhatsApp for business, e-commerce platforms, digital payment systems, and business management applications (Suri & Jack, 2024).

Market access and customer engagement strategies were assessed through questions examining online marketing activities, customer communication channels, market research practices, and customer relationship management approaches. The measurement focused on both the frequency of use and perceived effectiveness of different digital strategies in enhancing market access and customer engagement.

The qualitative data collection employed focus group discussions to capture rich, contextual information about women entrepreneurs' experiences with digital literacy and its impact on their business operations. The qualitative component was essential for understanding the underlying mechanisms through which digital literacy influences business performance and for exploring contextual factors that may not be captured through quantitative measures alone.

Focus group discussions were organized with groups of 8-10 women entrepreneurs to facilitate peer-to-peer discussions about digital literacy experiences and business performance outcomes. The focus groups were stratified based on business characteristics and digital literacy levels to ensure homogeneous group compositions that encouraged open discussion and sharing of experiences (Krueger & Casey, 2024).

The quantitative data analysis employed both descriptive and inferential statistical techniques using Stata version 17.0. Descriptive statistics were used to characterize the sample in terms of demographic characteristics, business attributes, digital literacy levels, and business performance indicators. Measures of central tendency, dispersion, and distribution were calculated for all continuous variables, while frequency distributions were generated for categorical variables.

Inferential statistical analyses were conducted to examine relationships between digital literacy and business performance indicators. Correlation analysis was performed to assess the strength and direction of

relationships between digital literacy scores and various business performance measures. Multiple regression analysis was employed to examine the predictive power of digital communication on business performance while controlling for potential confounding variables such as business age, entrepreneur's education level, and access to capital.

The qualitative data analysis followed a thematic analysis approach, employing both inductive and deductive coding strategies to identify patterns and themes related to digital literacy and business performance (Braun & Clarke, 2024). The analysis process was facilitated using NVivo 12 software to manage and organize the qualitative data systematically. The qualitative analysis also employed narrative analysis techniques to examine individual entrepreneurial journeys and the role of digital literacy in shaping business development trajectories. This approach provided insights into the temporal aspects of digital literacy development and its evolving impact on business performance over time

III. RESULTS AND DISCUSSIONS

3.1 Digital Communication and Business Performance

Digital communication was most widely adopted and impactful: 95.8% (n=203) used digital channels, with WhatsApp dominating at 87.3% adoption and 34.0% using WhatsApp Business. Mean communication frequency was 4.09 on a six-point scale. Effectiveness ratings were highest for receiving orders (mean 4.21, 76.8% very/extremely effective), answering questions (mean 4.08, 72.4%), and maintaining relationships (mean 3.95, 68.5%).

Digital communication improved operations substantially: 81.3% reported faster communication than traditional methods (mean 4.32), 76.8% responded more quickly to customer needs (mean 4.18), and 68.5% reached more customers (mean 3.98). Business outcomes were striking: 46.8% experienced 10%+ customer growth, 45.8% achieved 10%+ revenue growth, 60.4% expanded geographic reach, and 63.5% accelerated transaction speed. Mobile money integration (89.2% adoption) was critical, with 67.5% reporting increased purchase frequency when mobile money was available.

3.2 Digital Communication Impact and Business Performance Correlations

Digital communication impact, measured through frequency and effectiveness of digital communication channel use, showed the strongest correlations with business performance indicators among all digital literacy dimensions. The correlation with customer base size was particularly strong ($r=0.542$, $p<0.001$), representing a large effect size and indicating that communication capabilities directly enable customer base expansion. Monthly revenue showed a medium-to-large positive correlation ($r=0.487$, $p<0.001$), while overall business performance demonstrated a similar medium-to-large correlation ($r=0.456$, $p<0.001$).

Profit margins showed a moderate correlation with digital communication ($r=0.341$, $p<0.001$), which was notably weaker than the correlations with revenue and customer base. This pattern suggests that communication skills primarily drive business growth through customer acquisition and sales volume rather than through improved profit margins per transaction.

Table 3.1: Correlations Between Digital Communication and Business Performance

Business Performance Indicator	Correlation Coefficient (r)	Significance (p)	Effect Size
Customer base size	0.542***	<0.001	Large
Monthly revenue	0.487***	<0.001	Medium-Large
Overall business performance	0.456***	<0.001	Medium-Large
Profit margins	0.341***	<0.001	Medium

The strong correlations between digital communication and both customer base size ($r=0.542$) and monthly revenue ($r=0.487$) provide clear evidence that communication capabilities represent the most direct pathway through which digital literacy affects business performance in the cereals sector. The ability to communicate with customers via WhatsApp, coordinate orders, process mobile money payments, and maintain ongoing customer relationships emerged as the critical digital competency for business growth.

3.2 Hypothesis Testing: Digital Communication Impact (H₀₃)

Null Hypothesis H₀₃: There is no significant relationship between digital communication impact and performance of women-owned cereals enterprises in Mukuru Kwa Njenga slums in Nairobi City. Multiple regression analysis with overall business performance as the dependent variable and digital communication effectiveness as the primary independent variable produced a statistically significant model ($F(5, 206)=22.87$, $p<0.001$), with an R^2 of 0.357, indicating that the model explained 35.7% of variance in business performance—the highest explanatory power among individual digital literacy dimensions.

Digital communication impact showed a statistically significant positive relationship with business performance ($\beta=0.398$, $SE=0.063$, $t=6.32$, $p<0.001$), representing the strongest effect among all digital literacy

dimensions tested individually. Among control variables, education level ($\beta=0.142$, $p=0.015$) and business size ($\beta=0.167$, $p=0.008$) showed significant positive effects, while age ($\beta=-0.028$, $p=0.621$) and business tenure ($\beta=0.087$, $p=0.156$) were not significant.

Table 3.2: Regression Results for Digital Communication and Business Performance

Variable	B	SE	β (standardized)	t	p
Digital Communication	0.421	0.063	0.398	6.32	<0.001***
Age	-0.014	0.027	-0.028	-0.52	0.621
Education Level	0.098	0.041	0.142	2.39	0.015*
Business Tenure	0.048	0.033	0.087	1.45	0.156
Business Size (employees)	0.156	0.052	0.167	3.00	0.008**
Constant	1.287	0.298	—	4.32	<0.001***

Model: $F(5, 206)=22.87$, $p=0.000$

* $p<0.001$

Decision: The null hypothesis H_{03} is rejected. There is a significant positive relationship between digital communication impact and business performance among women-owned cereals enterprises. The standardized coefficient ($\beta=0.398$) indicates a medium-to-large effect size, confirming that communication capabilities represent the most impactful individual digital literacy dimension for business success.

Practical Interpretation: The significant relationship and large effect size indicate that digital communication skills represent the most critical digital competency for business performance in this context. Interventions focused on improving entrepreneurs' ability to communicate with customers via WhatsApp, coordinate orders digitally, and maintain customer relationships through digital channels would likely yield the strongest business performance improvements among all digital literacy interventions.

3.4 Digital Communication Enabling Market Expansion

Entrepreneurs described digital communication tools, particularly WhatsApp and mobile money, as transformative for customer acquisition, relationship maintenance, and geographic market expansion through reduced transaction costs, faster response times, and ability to serve customers across wider geographic areas.

This theme appeared in all 30 participants (100%), reflecting near-universal adoption of basic digital communication tools and its centrality to business performance.

Participants described WhatsApp as the primary tool for customer acquisition: "WhatsApp has completely changed my business. Before, I could only sell to customers who came to my shop or people in my neighborhood who knew me. Now, customers can message me from anywhere in Nairobi. They ask what I have, what the price is, and they can order without coming to my shop. I deliver to them or they send someone to pick up. I have customers now in Embakasi, in Kasarani, even in Kiambu. These are customers I would never have reached before."

Mobile money integration created seamless transaction completion: "The combination of WhatsApp and M-Pesa is very powerful. A customer messages me, I tell them the price, they send the money through M-Pesa, and I deliver or they pick up. The whole transaction can happen in less than an hour without the customer ever coming to my shop."

Geographic expansion was particularly significant: "I have customers who used to live in Mukuru but have moved to other areas. Because they can still reach me on WhatsApp and pay through M-Pesa, they continue to buy from me even though they live far away now. Some of them even recommend me to their friends in their new neighborhoods. So my business has expanded to areas I have never even visited."

This theme explains the strong correlation between digital communication and business performance ($r=0.512$ with monthly revenue, $r=0.498$ with customer base size) and the finding that 73.1% of entrepreneurs reported increased customer numbers since adopting digital communication.

13.4 Digital Communication and Market Expansion

Digital communication emerged as the most impactful dimension of digital literacy on business performance ($r=0.598$, p

Digital acquisition differs substantially from traditional word-of-mouth: it is faster (simultaneous reach through status updates or group messages), more scalable (not limited by physical presence), and enables targeting of specific customer segments. However, it requires different skills—creating compelling product descriptions, taking attractive photos, managing online inquiries, building trust with customers never met in person. One

entrepreneur described: "At first I just sent messages saying 'I have beans for sale.' But I learned that I need to send good photos, describe the quality, give the price clearly, and respond quickly when people ask questions."

Traditional face-to-face relationships in informal settlements are characterized by personal connection, trust through repeated interaction, credit relationships, and mutual knowledge. Digital communication enables reaching many more customers, but these relationships tend to be more transactional. "My WhatsApp customers just want the best price. They don't care about me personally. If someone else offers cheaper, they go there. It's not like my shop customers who come to me even if I'm a little more expensive because they know me." This trade-off between relationship depth and market breadth requires strategies for managing both customer types.

However, digital communication can also deepen existing relationships by making interaction more convenient. Regular customers appreciate checking product availability or placing orders via WhatsApp without traveling to the shop. "My regular customers love that they can message me to ask what I have before they come. It saves them time, and they actually buy from me more often now because it's easier."

Geographic market expansion represents one of the most significant impacts. Prior to digital adoption, most entrepreneurs served customers within walking distance. Digital communication, particularly WhatsApp combined with M-Pesa and delivery services, enables serving customers across Nairobi. The quantitative data showed 43.4% reported geographic expansion, with some serving customers in areas never physically visited.

Expansion typically follows social networks initially—entrepreneurs gain customers in other neighborhoods through referrals or participation in WhatsApp groups where they have social connections. "I joined a WhatsApp group for women in my church, and I started telling them about my cereals business. Now I have customers from that group all over Nairobi." As entrepreneurs gain experience, some expand beyond immediate networks through more proactive marketing—posting in business-focused groups, creating social media pages, or advertising in online forums. This requires greater digital communication skills and confidence.

Mobile money integration emerged as critical ($r=0.512$ correlation). Without M-Pesa, digital communication would enable customer contact but not transaction completion. Mobile money allows entire transactions remotely: customer inquires via WhatsApp, entrepreneur confirms availability and price, customer pays via M-Pesa, entrepreneur arranges delivery. "WhatsApp and M-Pesa work together. Without M-Pesa, I couldn't sell to customers far away because how would they pay me?"

However, integration introduces new challenges: managing timing of payment and delivery, handling disputes when products don't meet expectations, navigating trust challenges of remote transactions. Several entrepreneurs described customers who didn't pay after receiving goods, or who claimed goods were not as described and demanded refunds. Risk management strategies vary: "For new customers I don't know, I ask for payment before I send the goods. For customers who have bought from me before, I can send first and they pay after."

Infrastructure challenges—particularly connectivity reliability and data costs—significantly constrain benefits. Entrepreneurs frequently experience poor network connectivity, slow speeds, and outages that interrupt business communication. "Sometimes a customer sends me a message asking about products, but I don't receive it until hours later because the network is bad. By then, the customer has bought from someone else." These constraints are particularly problematic during high-demand periods when timely communication is most critical.

Data costs represent another significant constraint. While basic WhatsApp text messaging requires minimal data, sending photos, receiving voice messages, or using social media consumes substantial data. Entrepreneurs must balance business benefits of rich communication against data bundle costs. "I buy data when I have money, and then I send many photos and messages to customers. But when money is tight, I just send text messages without photos to save data. I know I probably lose some customers because they want to see photos, but I can't afford data all the time." This creates inequality in digital communication effectiveness.

Digital communication has fundamentally shifted customer expectations. Customers increasingly expect businesses to be reachable via WhatsApp, respond quickly to inquiries, accept mobile money payments, and provide product information digitally. Entrepreneurs who cannot meet these expectations risk losing customers to competitors. "Customers now expect that they can message you anytime and you'll respond quickly. If you don't have WhatsApp or you don't check your messages, they'll just go to another trader who does. It's not optional anymore."

This shift creates challenges for entrepreneurs with limited digital communication skills or device access. Those who cannot respond quickly (because they share phones, lack typing proficiency, or cannot afford data) are disadvantaged. However, digital communication also creates opportunities for differentiation. Entrepreneurs who communicate professionally, respond promptly, provide detailed information, and maintain good digital relationships can build reputations that attract customers. "I try to respond to every message within a few minutes, I send clear photos and descriptions, I'm polite and professional. Customers tell me they like doing business with me because I'm reliable and easy to communicate with."

Traditional informal sector commerce is characterized by localized supply chains, personal relationships, face-to-face transactions, and geographic constraints. Digital communication enables more dispersed supply

chains, relationship-at-a-distance, remote transactions, and geographic expansion. However, this transformation is not complete or universal—most entrepreneurs continue to serve primarily local customers and maintain traditional practices alongside digital channels. The most successful appear to integrate digital and traditional approaches, using digital communication to expand reach while maintaining personal relationships and local presence that provide business stability.

IV. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusion

Digital communication is the dominant pathway through which digital capabilities affect business performance, showing the strongest correlation with customer base size ($r=0.542$, $p<0.001$) and monthly revenue ($r=0.487$, $p<0.001$), and the largest standardized regression coefficient ($\beta=0.298$, $p<0.001$).

Digital communication drives performance through four mechanisms. First, it enables geographic market expansion: 60.4% of entrepreneurs expanded reach, with 26.4% now serving multiple Nairobi areas. Second, it accelerates transaction completion, with 63.5% reporting faster transaction times. Third, it facilitates customer relationship maintenance across distance and time. Fourth, integration with mobile money reduces transaction friction, with 67.5% reporting increased purchase frequency when mobile money is available.

Resource-constrained interventions should prioritize communication skills—WhatsApp use, mobile money integration, and customer relationship management—as highest return on investment capabilities.

4.2 Recommendations

Recommendations for Government Agencies

Prioritize infrastructure investment in informal settlements. Infrastructure deficits (electricity 58.5%, internet connectivity 58.5%) represent fundamental barriers. Government should extend reliable electricity supply to informal settlements, provide solar charging stations or community charging facilities where grid extension is not feasible, incentivize mobile network operators through regulatory requirements or subsidies to improve network coverage, and invest in public Wi-Fi hotspots in market areas.

Adapt regulatory frameworks for digital commerce in informal contexts. Government should develop regulations governing digital commerce, mobile money, and online business that accommodate informal sector realities. Tax policies should provide clear guidance on obligations for digital commerce by informal businesses, reducing fears of punitive enforcement while ensuring appropriate revenue collection.

Establish universal electricity and internet access targets. Government should set explicit targets (e.g., 90% electricity access within 5 years, 80% reliable internet within 7 years) with dedicated budget allocations and accountability mechanisms, recognizing infrastructure access as essential for economic participation.

Integrate digital literacy into national education and skills development systems. With 68.4% receiving no formal training, government should integrate digital literacy into curricula at all levels and support training through TVET institutions, community learning centers, and partnerships with development organizations.

Recommendations for Development Organizations

Implement peer-based learning models. With 64.2% receiving technology support from family and 93% preferring peer learning, programs should use successful women entrepreneurs as trainers or mentors, create peer learning groups that continue beyond formal training, and facilitate knowledge-sharing networks. Peer-based models leverage existing community relationships and provide culturally appropriate learning environments.

Ensure flexible delivery formats. Time constraints from dual responsibilities limit participation. Training should be offered in short sessions (1-2 hours), at times when business is slow (early mornings, Sunday afternoons), in accessible locations, and through mobile-based delivery (video tutorials, WhatsApp-based learning groups, phone-based coaching). Modular design should allow participation in individual sessions.

Provide training in local languages with literacy-appropriate materials. With 42.5% facing language barriers, programs should deliver training in Kiswahili and other local languages with materials designed for limited literacy. Visual demonstrations, hands-on practice, and oral instruction should be emphasized over text-heavy materials.

Establish sustained support mechanisms beyond initial training. With 93% emphasizing need for ongoing support, programs should include WhatsApp help groups, periodic refresher sessions (monthly or quarterly), and access to advisors for individualized support.

Integrate gender-responsive design throughout programs. Women face gender-specific barriers (household technology control, time poverty, gender norms). Programs should support women's personal device ownership through subsidized financing, provide childcare during training, schedule training compatible with domestic responsibilities, offer women-only learning spaces, and engage household members to build support.

Recommendations for Technology Providers

Develop simplified business management applications for informal sector micro-enterprises. Advanced tools show low adoption (accounting 8.5%, inventory 6.6%) due to complexity (42.5% cite as barrier). Technology providers should create applications with intuitive interfaces requiring minimal training, minimal data requirements, offline functionality, and content in local languages, designed based on research with informal entrepreneurs.

Implement affordability mechanisms for low-income users. Cost represents a major barrier (data 64.5%, subscription fees 34.0%). Technology providers should offer free or heavily subsidized versions for micro-enterprises, tiered pricing with low-cost entry levels, pay-as-you-go models, and bundled packages combining devices, connectivity, and software. Mobile network operators should offer business data packages at rates lower than consumer packages.

Design for low-bandwidth and intermittent connectivity contexts. With 58.5% experiencing slow speeds and poor connectivity, applications should have lightweight data requirements (compressed images, text-based interfaces, minimal video), offline-first architecture with data synchronization when connectivity is available, progressive loading prioritizing essential content, and adaptive quality adjusting to available bandwidth. Applications should be tested in actual informal settlement conditions.

Provide multilingual support and literacy-appropriate interfaces. With 42.5% facing language barriers, technology providers should offer applications in multiple Kenyan languages (Kiswahili, Kikuyu, Luo, others), use voice-based interfaces and audio instructions, incorporate visual icons and graphics, and provide video tutorials in local languages. Interface design should assume diverse literacy levels.

Establish feedback mechanisms with informal sector users. Technology providers should establish user advisory panels of informal sector entrepreneurs, conduct regular usability testing in informal settlement contexts, create channels for user suggestions informing product development, and share usage data with the broader development community.

Integrate digital literacy support into applications. With 68.4% receiving no formal training, applications should incorporate in-app tutorials guiding users step-by-step, contextual help explaining features, practice modes for experimentation without affecting real data, and video demonstrations showing how other entrepreneurs use applications.

Recommendations for Business Associations and Informal Sector Organizations

Establish peer learning networks and digital champions programs. With 93% emphasizing peer learning value, associations should identify digitally-proficient members as "digital champions" providing mentoring, organize regular peer learning sessions, create WhatsApp groups for questions and support, and facilitate experience-sharing visits.

Negotiate collective benefits with technology providers. Cost represents a major barrier (data costs 64.5%, subscription fees 34.0%). Associations should negotiate group discounts on business software, arrange bulk purchase agreements for devices, negotiate preferential data rates with mobile network operators, and explore partnerships for subsidized or free access to business management tools.

Advocate for infrastructure investment and supportive policies. Infrastructure deficits (electricity 58.5%, internet connectivity 58.5%) represent fundamental barriers. Associations should advocate for infrastructure investment in informal settlements, participate in urban planning processes, engage with regulatory agencies to ensure policies accommodate informal sector realities, and document economic contributions to build political support.

Provide business development services incorporating digital literacy. With 68.4% receiving no formal training, associations should integrate digital literacy into existing business development programs, offer training designed for informal sector contexts addressing actual business applications, provide ongoing support and refresher training, and connect members with external resources.

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