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Digital Entrepreneurship as a Predictor of Agile Co-Creation among Women Entrepreneurs in Ashaka Town, Nigeria

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Abstract

In semi-urban developing economies, women entrepreneurs increasingly rely on low-cost digital platforms to sustain adaptive and collaborative business practices under conditions of infrastructural and financial constraint. Yet limited empirical attention has been devoted to understanding how digital entrepreneurship shapes agile co-creation within localized entrepreneurial ecosystems in northeastern Nigeria. This study examines digital entrepreneurship as a predictor of agile co-creation among women entrepreneurs in Ashaka Town, Nigeria. Using a simulation-based quantitative explanatory design, the study employed literature-informed synthetic survey modelling to generate 220 entrepreneurial cases reflecting plausible business patterns within a semi-urban economy. Data were analyzed using descriptive statistics, Pearson correlation, and simple linear regression. The findings revealed a positive and statistically significant predictive relationship between digital entrepreneurship and agile co-creation. Mobile-centered digital practices (particularly WhatsApp business use, social-media marketing, mobile banking, and digital payments) emerged as dominant entrepreneurial adaptation mechanisms. The results further suggest that collaborative responsiveness among women entrepreneurs is strengthened through digitally mediated customer interaction, peer networking, and adaptive business coordination. The study also highlights persistent constraints related to infrastructure, digital capacity, and access to digital resources. The study contributes localized evidence on women's digital entrepreneurship in semi-urban Nigeria and demonstrates the analytical value of synthetic-data modelling for exploratory entrepreneurship research. The findings suggest that low-cost digital infrastructures can strengthen collaborative entrepreneurial adaptability and resilience among women-owned enterprises in resource-constrained economies.

Keywords: *Digital Entrepreneurship; Agile Co-Creation; Women-Owned SMEs; Synthetic-Data Modelling; Semi-Urban Entrepreneurship; Mobile Commerce; Northeast Nigeria.*

Introduction

The accelerating expansion of digital technologies has fundamentally transformed entrepreneurial activity across both developed and developing economies. Digital entrepreneurship has emerged as an important mechanism through which individuals and small businesses create, market, coordinate, and sustain economic activities using internet-enabled systems, mobile technologies, social-media platforms, and digital financial tools. Across developing economies, women entrepreneurs increasingly rely on digital platforms to overcome long-standing structural barriers associated with limited mobility, weak market access, inadequate financing, and socio-cultural restrictions (Aracil-Jordá *et al.*, 2023; Gupta *et al.*, 2025; Zarrilli, 2026). In many contexts, digital entrepreneurship is no longer viewed solely as a technological phenomenon; rather, it represents an adaptive entrepreneurial response to economic uncertainty, infrastructural deficits, and evolving market realities.

The digitalization of SMEs has become particularly significant in resource-constrained and semi-urban economies where formal entrepreneurial infrastructures remain underdeveloped. Research consistently shows that digital entrepreneurship enhances operational flexibility, customer engagement, business efficiency, and entrepreneurial resilience among SMEs operating within uncertain environments (Franco *et al.*, 2021; Wanzala & Ogechukwu Obokoh, 2025). Social-media platforms such as WhatsApp, Facebook, and Instagram increasingly function as low-cost commercial infrastructures through which entrepreneurs advertise products, maintain customer relationships, process transactions, and coordinate supply networks (Fatima & Ali, 2023; Marolt *et al.*, 2022). These platforms also provide important spaces for peer learning, collaborative adaptation, and network-based entrepreneurship, especially among women-owned enterprises operating outside formal institutional support systems (Dale *et al.*, 2026; Tarafder *et al.*, 2026).

Women entrepreneurship occupies a particularly important position within developing economies because women-owned enterprises contribute substantially to household welfare, employment generation, poverty reduction, and local economic development. However, women entrepreneurs continue to operate within environments characterized by infrastructural inadequacies, weak access to formal finance, patriarchal social norms, and gendered restrictions on economic participation (Olumba *et al.*, 2023). Studies indicate that many women-owned enterprises depend heavily on informal business structures, indigenous savings systems, community-based support mechanisms, and relational networks to sustain business continuity under conditions of uncertainty. Consequently, women entrepreneurs often combine informal entrepreneurial practices with digital

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adaptation strategies in order to navigate economic and social constraints.

Within this context, mobile-enabled business practices have become increasingly central to entrepreneurial survival and growth. Women entrepreneurs in developing economies commonly utilize mobile phones, mobile banking applications, WhatsApp Business, Facebook Marketplace, POS systems, and online referral networks to facilitate transactions and sustain customer engagement (Karyotaki *et al.*, 2022; Gupta *et al.*, 2025). In semi-urban African settings, these forms of digital adaptation are often incremental and practical rather than highly sophisticated. Entrepreneurs typically use digital technologies not for large-scale technological transformation, but for business continuity, flexible communication, customer retention, and low-cost market participation (Emembolu *et al.*, 2022; Ojong *et al.*, 2021). Research further suggests that targeted digital-skills training, social-media competence, and peer-learning mechanisms improve women's confidence in using digital platforms and contribute to greater entrepreneurial resilience (Emembolu *et al.*, 2026; Ochinanwata & Ochinanwata, 2023).

Contemporary entrepreneurship literature increasingly emphasizes collaboration, adaptability, and agile co-creation as critical entrepreneurial capabilities within dynamic and resource-constrained environments. Agile co-creation refers to flexible and collaborative entrepreneurial processes through which businesses continuously adapt products, services, customer engagement strategies, and operational practices in response to changing market conditions and stakeholder interactions. Existing evidence shows that women entrepreneurs frequently leverage digital ecosystems, social-media groups, cooperative networks, affinity associations, and informal learning communities as spaces for collaboration, innovation, and collective problem-solving (Eneh Ojo *et al.*, 2022). Informal digital communities built around WhatsApp and Facebook increasingly serve as entrepreneurial ecosystems where women exchange market information, coordinate sales activities, share business experiences, and collectively navigate economic uncertainty (Tarafder *et al.*, 2026; Dale *et al.*, 2026). These collaborative structures strengthen entrepreneurial adaptability and enable forms of co-creation that are embedded within everyday entrepreneurial practice.

DCT provides an important explanatory framework for understanding the relationship between digital entrepreneurship and agile co-creation. The theory explains how entrepreneurs identify opportunities, mobilize resources, adapt capabilities, and reconfigure organizational practices within changing environments (Adesanya *et al.*, 2024; Wang & Thai, 2026). In digitally mediated entrepreneurial contexts, women entrepreneurs engage in sensing digital opportunities, seizing market possibilities through digital platforms, and transforming business processes through collaborative learning and technological adaptation (Durman *et al.*, 2025). Consequently, digital entrepreneurship can be understood not merely as technology adoption, but as a dynamic capability that enables flexibility, innovation, collaboration, and resilience.

These issues are increasingly relevant within semi-urban economies in northeastern Nigeria, particularly in communities where industrial activity, agriculture, petty trade, and informal entrepreneurship coexist. Ashaka Town in Funakaye Local Government Area of Gombe State represents one such context. The town's economy is shaped largely by the presence of the Ashaka Cement Company alongside agricultural production, local trading activities, transport services, tailoring, catering, and small-scale retail enterprises. Women entrepreneurs play a central role within this local economy through participation in agro-processing, food vending, tailoring, cosmetics, petty trade, and household-consumable production. More recently, women-owned enterprises in Ashaka have increasingly integrated mobile-enabled business practices into their commercial activities, particularly through WhatsApp communication, Facebook marketing, mobile transfers, POS transactions, and digitally coordinated customer engagement.

Despite the growing visibility of digital entrepreneurship among women-owned enterprises, women entrepreneurs in semi-urban Nigeria continue to face persistent barriers that limit the transformative potential of digital technologies. These barriers include unstable electricity supply, poor internet connectivity, high data costs, low digital literacy, limited access to smartphones, weak financial inclusion, and socio-cultural restrictions on women's economic participation (Ojong *et al.*, 2021; Akinyemi *et al.*, 2020). In many cases, patriarchal norms and male gatekeeping continue to influence women's control over financial resources, technology use, and business visibility (Olumba *et al.*, 2023). As a result, women entrepreneurs frequently rely on adaptive and collaborative strategies that combine informal support systems with accessible digital tools.

Although existing studies acknowledge the importance of digital entrepreneurship, relatively limited empirical attention has been devoted to understanding how digital entrepreneurship predicts agile co-creation among women entrepreneurs operating within semi-urban and resource-constrained African economies. Much of the literature focuses on broad digital inclusion, general SME digitalization, or urban entrepreneurial ecosystems, while localized studies examining collaborative entrepreneurial adaptation among women-owned enterprises in northeastern Nigeria remain limited (Nziku & Henry, 2021; Ogundana *et al.*, 2024). Furthermore, there is limited empirical evidence specifically examining the predictive relationship between digital entrepreneurship and agile co-creation within semi-urban entrepreneurial ecosystems such as Ashaka Town. Against this background, the present study examines digital entrepreneurship as a predictor of agile co-creation among women entrepreneurs in Ashaka Town, Nigeria. The study specifically seeks to assess digital entrepreneurship practices, examine agile co-creation behaviors, determine the predictive relationship between both constructs, and identify barriers affecting digital entrepreneurial practices among women entrepreneurs.

The study is guided by the following null hypothesis:

H_{01}: *Digital entrepreneurship does not significantly predict agile co-creation among women entrepreneurs in Ashaka Town.*

Literature Review and Theoretical Framework

Concept of Digital Entrepreneurship

Digital entrepreneurship refers to entrepreneurial activity that is created, delivered, organized, or expanded through digital technologies. In the literature, it is no longer treated as a narrow matter of "using the internet," but as a broader capability to identify opportunities, mobilize digital tools, and convert online connectivity into market value. Studies on women-owned micro and small enterprises repeatedly show that digital entrepreneurship is closely associated with social-media commerce, mobile banking, digital payments, and platform-based customer engagement (Franco *et al.*, 2021; Mousa *et al.*, 2024; Olsson & Bernhard, 2021). In this sense, the concept is especially relevant to small enterprises operating in environments where formal business infrastructure is weak but mobile access is widespread.

The most visible expression of digital entrepreneurship in semi-urban and developing economies is mobile-enabled business practice. Women entrepreneurs use WhatsApp, Facebook, and similar platforms not simply for communication, but for marketing, order-taking, customer feedback, and transaction coordination. The evidence indicates that these tools lower entry barriers because they require less capital than physical expansion and can be used even where formal markets are difficult to access (Aracil-Jordá *et al.*, 2023; Fatima & Ali, 2023; Zarrilli, 2026). Social-media commerce is therefore not peripheral to digital entrepreneurship; it is one of its most practical forms in women-led micro-enterprise settings. Digital tools also support low-cost digitalization by allowing firms to remain visible, responsive, and commercially active without needing highly sophisticated systems (Marolt *et al.*, 2022; Wanzala & Ogechukwu Obokoh, 2025).

Within the uploaded literature, digital entrepreneurship is consistently linked to adaptability under constraint. Women entrepreneurs are shown to use mobile tools as survival technologies in contexts of unreliable electricity, poor internet connectivity, weak transport systems, and limited market access (Emembolu *et al.*, 2026; Ochinanwata & Ochinanwata, 2023). The value of these tools lies not in technological glamour but in practical business continuity. They enable bookkeeping, customer communication, payment collection, and product promotion in ways that are both affordable and flexible. In this respect, digital entrepreneurship should be understood as a form of incremental business adaptation rather than as a fully transformed digital enterprise. That distinction matters for Ashaka Town, where the likely pattern is pragmatic digital adoption rather than advanced e-commerce specialization.

Concept of Agile Co-Creation

Agile co-creation describes a collaborative business process in which value is produced through adaptive interaction among entrepreneurs, customers, peers, and other stakeholders. It is "agile" because it emphasizes flexibility, speed, and responsiveness; and it is "co-creation" because value emerges from shared contribution rather than one-way business delivery. In the uploaded sources, this concept is repeatedly connected to digital ecosystems, peer learning, informal networks, and customer engagement. Women entrepreneurs do not merely sell online; they refine products, test ideas, negotiate demand, and adjust offers through ongoing interaction with customers and collaborators (Dale *et al.*, 2026; Tarafder *et al.*, 2026).

The literature shows that social-media platforms often function as co-creation spaces. WhatsApp groups, Facebook communities, and similar digital spaces allow women to exchange business information, coordinate supply activities, and collectively solve problems. Such platforms support relational capability: repeat orders, referrals, trust-building, and loyalty formation become possible because customers are no longer passive recipients but active participants in the business process (Fatima & Ali, 2023; Jiménez-Zarco *et al.*, 2021; Marolt *et al.*, 2022). This is particularly important in low-trust or resource-constrained environments where formal support systems are thin. In these settings, agile co-creation provides a realistic model of entrepreneurial collaboration grounded in everyday practice rather than in abstract innovation rhetoric.

The uploaded documents also show that agility is tied to resilience. Women entrepreneurs adapt quickly to disruptions by shifting products, changing channels, and mobilizing peer support or digital mentoring networks (Jayasuriya *et al.*, 2025; Rahayu *et al.*, 2023). Their collaborative behavior is often not formalized in incubators or innovation hubs; instead, it emerges through informal digital ecosystems and local trust networks. Thus, agile co-creation among women entrepreneurs can be understood as a dynamic response to uncertainty: a way of converting digital access, social capital, and entrepreneurial flexibility into business survival and gradual growth (Best, 2025; Eneh Ojo *et al.*, 2022).

Women Entrepreneurship in Semi-Urban Economies

Women entrepreneurship in semi-urban economies is shaped by informality, gendered constraints, and uneven access to markets and capital. The uploaded materials consistently present women-owned micro and small enterprises as central to household welfare and local economic life, especially in settings where formal employment opportunities are limited (Ojong *et al.*, 2021). Yet these enterprises operate within structural conditions that constrain scale: inadequate infrastructure, restricted access to finance, gendered social expectations, and limited business support services. In Ashaka-like economies, women entrepreneurs often remain embedded in petty trade, food vending, tailoring, cosmetics, agro-processing, and home-based services, while simultaneously experimenting with digital tools where possible.

What emerges from the evidence is a pattern of resilience under constraint. Women entrepreneurs compensate for weak formal systems through informal savings groups, peer networks, family support, and low-data digital channels. In the uploaded Nigeria-focused synthesis, women in semi-urban contexts are shown to rely on indigenous savings systems, community workshops, and low-cost digital platforms to sustain business continuity despite patriarchal control and weak financial inclusion (Olumba *et al.*, 2023; Rekha *et al.*, 2024). Similarly, the Ashaka-specific synthesis argues that mobile-enabled practices, social-media commerce, and digital payments help women navigate infrastructural and economic barriers while maintaining business continuity and gradual growth.

Semi-urban economies are particularly important because they occupy a middle position between rural informality and urban formalization. This makes them analytically useful for studying digital adaptation under constraint. In these settings, digital entrepreneurship is unlikely to appear as high-end technological disruption. Instead, it is likely to appear as practical business adjustment: selling through WhatsApp, receiving payments digitally, using Facebook for visibility, and maintaining customer relationships through mobile communication (Karyotaki *et al.*, 2022; Zarrilli, 2026). Ashaka Town fits this pattern well, since the uploaded documents describe a hybrid economy shaped by industry, agriculture, petty trade, and women-led microenterprise activity.

Theoretical Framework: Dynamic Capability Theory (DCT)

DCT offers the strongest explanatory frame for this study because it explains how enterprises sense opportunities, seize them, and transform their resource base in response to changing conditions. Across the uploaded documents, DCT appears as the central lens connecting digital adaptation, resilience, collaborative learning, and co-creation (Adesanya *et al.*, 2024; Wang & Thai, 2026; Yamamoto *et al.*, 2026). The theory is useful here because women entrepreneurs in Ashaka are not simply adopting technology; they are reorganizing their business practices, social relations, and customer engagement patterns in ways that require flexibility and reconfiguration.

DCT is especially appropriate for digital entrepreneurship because digital tools alter opportunity recognition. Women entrepreneurs sense opportunities through customer trends, social-

media interactions, and platform affordances; they seize these opportunities by using digital payment systems, online marketing, and digital communication tools; and they transform their business routines by reconfiguring how they sell, interact, and collaborate (Civelek *et al.*, 2023; Durman *et al.*, 2025; Teoh *et al.*, 2024). In the uploaded literature, this sensing–seizing–transforming sequence is repeatedly linked to women's digital resilience and business growth.

The theory also fits agile co-creation because collaborative value creation depends on ongoing adaptation. Women entrepreneurs use networks, digital groups, and peer learning to exchange resources and respond rapidly to market signals. DCT therefore helps explain why some women entrepreneurs move beyond simple technology use toward deeper forms of collaborative business adaptation. In semi-urban settings such as Ashaka, where institutions are weak and uncertainty is high, this dynamic capability perspective is especially helpful because it frames entrepreneurship as a process of continuous reconfiguration rather than static ownership (Farago *et al.*, 2019). For this study, DCT is the most suitable framework because it links digital entrepreneurship directly to flexibility, adaptation, and co-created business value.

Empirical Review

The empirical literature in the uploaded documents consistently shows that digital entrepreneurship improves SME performance, especially among women-owned and micro enterprises. Franco *et al.* (2021) and Wanzala and Ogechukwu Obokoh (2025) demonstrate that digital entrepreneurship enhances efficiency, customer relations, and internal management capabilities. Mousa *et al.* (2024) add that female digital entrepreneurs build autonomy and resilience through digital literacy, platform experience, and community networks. In Nigeria, Amuda and Alabdulrahman (2024) also show that women's immersion in digital entrepreneurship expands opportunity access and economic participation. These findings suggest that digital entrepreneurship is not merely an accessory to business performance; it is a capability-enhancing catalyst.

A second cluster of studies focuses on social-media business practices and collaboration. Social-media use is associated with performance, innovation, customer engagement, sustainability, and opportunity recognition (Borah *et al.*, 2022; Bruce *et al.*, 2023; Fatima & Ali, 2023). The literature also shows that for women-owned SMEs, social-media platforms can function as informal spaces for co-creation and market-driven agility (Best, 2025; Tarafder *et al.*, 2026). This is especially relevant for Ashaka, where mobile communication is more realistic than large-scale e-commerce infrastructure.

A third stream concerns digital payments and financial inclusion. QR and mobile payments improve income stability, transaction volume, credit access, and performance among small businesses (Gupta *et al.*, 2025; Nahar, 2022). At the same time, adoption depends on trust, privacy, security, and ease of use (Manrai *et al.*, 2021; Salah & Ayyash, 2025). In developing economies, digital finance strengthens resilience by reducing dependence on cash and enabling faster business continuity. Finally, collaborative networking studies show that social capital, digital groups, and platform ecosystems support opportunity recognition, co-learning, and resilience (Eneh Ojo *et al.*, 2022; Mamabolo & Lekoko, 2021). Taken together, the empirical literature points to a clear relationship between digital entrepreneurship and collaborative entrepreneurial behavior.

Identified Gap in Literature

Despite the growing volume of research on digital entrepreneurship, three gaps remain visible in the uploaded documents. First, most studies are still broad, regional, or cross-country in scope, with limited Ashaka Town-specific evidence. Second, the literature emphasizes digital entrepreneurship, social-media use, or resilience separately, but less often tests the direct predictive link between digital entrepreneurship and agile co-creation among women entrepreneurs. Third, while the role of women in semi-urban economies is well recognized, localized evidence from northeastern Nigeria remains thin. The present study addresses these gaps by focusing on women entrepreneurs in Ashaka Town and examining digital entrepreneurship as a predictor of agile co-creation.

Conceptual Model

Figure 1 conceptually presents digital entrepreneurship as the explanatory variable and agile co-creation as the outcome variable. In line with the literature, digital entrepreneurship may be understood through indicators such as mobile banking, social-media commerce, online referrals, and digital payments, while agile co-creation may be reflected in customer participation, collaborative adaptation, and network-based business responsiveness. The model is intentionally simple because it is designed to test a direct relationship in a localized semi-urban setting.

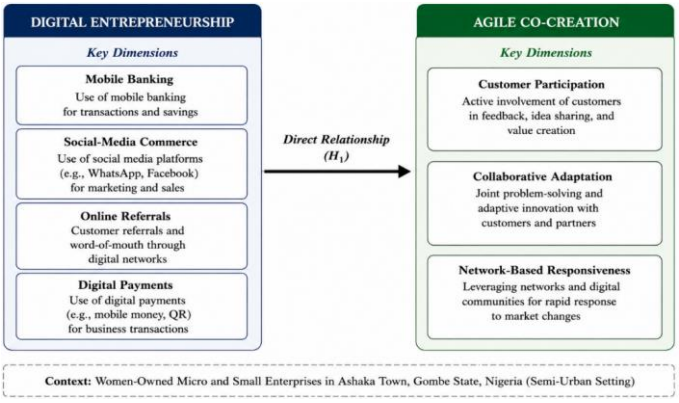

Figure 1. Conceptual Framework

Methodology

Research Design

This study adopts a simulation-based quantitative explanatory design using synthetic survey data. The design is appropriate because the study seeks not to describe a field-collected population directly, but to model a plausible entrepreneurial environment in which digital entrepreneurship may predict agile co-creation among women entrepreneurs in Ashaka Town. The methodological logic is exploratory and analytical: it uses literature-informed parameterization to construct a survey-like dataset that reflects realistic entrepreneurial conditions, while remaining transparent about its simulated nature. This approach is consistent with current work on synthetic social-science data, survey reconstruction, and quantitative entrepreneurship modelling, where generated datasets are used to preserve structural patterns, test inferential relationships, and examine measurement behaviour under controlled conditions (Chang, 2025; Jiang *et al.*, 2025; Kohnert & Kreutz, 2025; Vadisetty *et al.*, 2026).

The study is therefore not a field survey and does not claim direct empirical contact with respondents. Rather, it is an exploratory modelling exercise that simulates the type of responses one

would expect from women entrepreneurs operating in a semi-urban economy such as Ashaka. The literature on simulated Likert-scale datasets shows that such models can be constructed to preserve realistic response distributions, moderate covariance, and inferential validity, provided that the assumptions behind the simulation are clearly stated (Druica *et al.*, 2025; Sideridis *et al.*, 2023; Wang & Hau, 2025).

Study Area

The study is located conceptually in Ashaka Town, Funakaye Local Government Area, Gombe State. The uploaded documents describe Ashaka as a semi-urban setting shaped by industrial activity, agriculture, petty trade, and microenterprise livelihoods. The town's economy is anchored by the Ashaka Cement Company and extended by surrounding commercial and agricultural activities, creating a hybrid environment in which women entrepreneurs operate through retail, food processing, tailoring, cosmetics, and related micro-businesses. In such a setting, women-owned enterprises are central to household welfare, local circulation of goods, and adaptive business survival.

This context is analytically important because it combines structural constraint with entrepreneurial opportunity. The literature on women in semi-urban Nigeria shows that such economies are marked by infrastructural deficits, weak formal finance, and gendered barriers, yet they also provide fertile ground for mobile-enabled adaptation, social-media commerce, and network-based support systems. Ashaka therefore offers a useful micro-setting for examining whether digital entrepreneurship can stimulate agile co-creation under resource-constrained conditions (Emembolu *et al.*, 2022; Ojong *et al.*, 2021).

Population and Sample

The target population consists of women-owned micro and small enterprises operating in Ashaka Town. Because the study uses synthetic data, the population is treated as a conceptual reference frame rather than a directly enumerated sampling universe. The analytical sample comprises 220 synthetic entrepreneurial cases, which is sufficient for descriptive statistics, correlation analysis, and simple linear regression. The sample size also allows for sectoral differentiation while preserving statistical manageability.

A stratified structure was used to reflect the broad economic composition of women's enterprise participation in Ashaka-like semi-urban settings (Table 1). The distribution is assumption-based and represents a plausible simulation frame rather than a census count. This is consistent with the synthetic-survey literature, which supports the embedding of stratification and controlled distributional design into generated datasets (Jiang *et al.*, 2025; Zhang *et al.*, 2025).

Table 1. Sectoral Distribution of Synthetic Entrepreneurial Sample

Sector	Percentage	Sample Size
Agro-Processing & Food Trade	28%	62
Retail/Petty Trading	24%	53
Fashion & Tailoring	18%	40
Food Services & Catering	10%	22
Cosmetics and Household Consumables	10%	22
Digital/Online Commerce	6%	13
Logistics/Support Services	4%	8
Total	**100%**	**220**

Note: Distribution represents assumption-based sectoral simulation.

Table 2. Variable Construction Framework

Variable	Indicators	Scale
Digital Entrepreneurship	WhatsApp business use, mobile banking, social-media marketing, digital payments	5-point Likert
Agile Co-Creation	Customer feedback integration, collaborative adaptation, peer networking	5-point Likert

Synthetic Data Generation Procedure

The synthetic dataset was generated using literature-informed simulation logic. The procedure draws on recent scholarship showing that synthetic survey variables can be constructed from correlated distributions, generative methods, and survey-informed parameterization so that the resulting data resemble realistic entrepreneurial responses (Chang, 2025; Choenni *et al.*, 2023; Busker *et al.*, 2025; Kothare *et al.*, 2021; Vadisetty *et al.*, 2026; Yadav *et al.*, 2024). The present study adopts this logic by generating Likert-type responses for the key constructs of digital entrepreneurship and agile co-creation, with moderate correlations introduced to reflect a plausible predictive relationship rather than artificial perfection.

The simulation was designed to represent the response patterns likely to emerge among women entrepreneurs in a semi-urban Nigerian environment. Digital entrepreneurship was modeled through indicators such as WhatsApp business use, mobile banking, social-media marketing, and digital payments; agile co-creation was modeled through customer participation, collaborative adaptation, and network-based responsiveness (Table 2). The literature on Likert-scale simulation emphasizes the importance of preserving realistic midpoint behaviour, response variability, and modest covariance across items, because excessively clean data can undermine credibility and distort inference (Druica *et al.*, 2025; Lehtonen *et al.*, 2025; Pokropek, 2026; Wang & Hau, 2025).

Accordingly, the synthetic data were not designed to display statistical perfection. Random variation was deliberately introduced so that the dataset would contain heterogeneity, moderate internal consistency, and plausible entrepreneurial diversity. This is aligned with the methodological literature showing that synthetic datasets are most credible when they preserve univariate and bivariate structure without appearing mechanically idealized (El-Emam *et al.*, 2024; Mathur *et al.*, 2024; Zhang *et al.*, 2025).

Instrument Structure

The study uses a structured simulated questionnaire divided into four sections (Table 3). Section A captures demographic and enterprise-related information, while Sections B and C measure

digital entrepreneurship and agile co-creation respectively. Section D captures entrepreneurial barriers, including infrastructure, finance, and social constraints. This structure is consistent with the survey-like design recommended in synthetic entrepreneurship research, where construct items are separated clearly to allow later testing of reliability and dimensional coherence (Douglas *et al.*, 2020; Martínez-González *et al.*, 2022; Pagotto & Borges, 2023).

Table 3. Questionnaire Structure

Section	Focus
A	Demographics
B	Digital Entrepreneurship
C	Agile Co-Creation
D	Entrepreneurial Barriers

Validity and Reliability

Validity in this study is conceptual and content-based. Because the data are synthetic, the main validity concern is whether the simulated indicators faithfully represent the theoretical constructs they are intended to model. To ensure this, the item structure was aligned with the literature on women's digital entrepreneurship, social-media commerce, and collaborative adaptation. Expert review and conceptual triangulation were used to check whether the simulated items adequately represented the intended domains. This is consistent with work showing that entrepreneurship scales can be designed and validated even in simulated or reconstructed environments when construct boundaries are clear and item logic is coherent (Geraldo-Campos *et al.*, 2022; Cárdenas Gutiérrez *et al.*, 2021; Nurluöz & Esmaeilzadeh, 2020).

Internal consistency was assessed using Cronbach's alpha, with the conventional threshold of 0.70 adopted as the minimum acceptable benchmark. The synthetic-data literature supports alpha, composite reliability, and related scale-assessment tools as suitable for generated survey datasets, provided that their interpretation remains tied to the simulation design (Aslam, 2026; Kohnert & Kreutz, 2025; Zhang & Li, 2025). Table 4 shows the planned reporting format for reliability statistics, using illustrative coefficients to demonstrate the expected presentation of the simulated instrument.

Table 4. Reliability Statistics

Construct	No. of Items	Cronbach's α
Digital Entrepreneurship	6	0.81
Agile Co-Creation	5	0.79

Method of Data Analysis

The simulated dataset will be analyzed using descriptive statistics, Pearson correlation, and simple linear regression in SPSS. Descriptive statistics will summarize the distribution of the constructed variables; correlation analysis will establish the direction and magnitude of the association between digital entrepreneurship and agile co-creation; and regression analysis will test the predictive effect of the explanatory variable on the outcome variable. This analytic sequence follows established approaches in quantitative entrepreneurship research and simulation-based modelling, where regression and related techniques are routinely used to examine behavioural and contextual predictors of entrepreneurial outcomes (Douglas *et al.*, 2020; Martínez-González *et al.*, 2022).

The regression model is specified as:

$$ACO = \beta_0 + \beta_1 DE + \epsilon$$

Where:

ACO = Agile Co-Creation
DE = Digital Entrepreneurship

This specification is deliberately parsimonious because the study is designed to test a direct relationship in a localized semi-urban setting, rather than to estimate a highly complex causal model. The methodological literature on synthetic data further suggests that parsimonious models are preferable when the objective is to preserve interpretability and ensure credible replication across simulated datasets (Borders *et al.*, 2025; Kulal, 2026; El-Emam *et al.*, 2024).

Ethical Considerations and Study Limitations

The study uses synthetic data and therefore does not involve direct human respondents, personal identifiers, or field-based consent procedures. This approach reduces privacy risk, but it does not eliminate all ethical concerns. The synthetic-data literature was used with caution. For that reason, the study treats synthetic modelling as exploratory and transparent rather than as a substitute for empirical fieldwork (Fitzgerald, 2024; Patel, 2024; Susser *et al.*, 2024).

The main limitation is therefore interpretive rather than procedural: the findings will illustrate a plausible statistical relationship, not a verified account of actual respondents in Ashaka Town. This limitation is acknowledged deliberately because the ethical and methodological literature on synthetic social science emphasizes transparency, traceability, and avoidance of overclaiming (El-Sayed, 2026; Susser & Seeman, 2024).

Results

Demographic Characteristics

Table 5 shows the demographic distribution of the 220 synthetic cases. The largest age group was 31–40 years (36.4%), followed by 21–30 years (29.1%). Secondary education was the most common educational level (40.9%). Most respondents had been in business for 4–7 years (38.2%). By sector, agro-processing and food trade accounted for the largest share (28.2%), followed by retail/petty trading (24.1%) and fashion/tailoring (18.2%).

Descriptive Analysis of Digital Entrepreneurship

Table 6 presents the descriptive statistics for digital entrepreneurship indicators. WhatsApp business use recorded the highest mean (M = 4.31, SD = 0.71), followed by social-media marketing (M = 4.08, SD = 0.83). Mobile banking usage had a mean of 3.96 (SD = 0.78), digital payment adoption had a mean of 3.88 (SD = 0.86), and online customer referrals had the lowest mean (M = 3.67, SD = 0.92). The aggregate mean for digital entrepreneurship was 3.98 (SD = 0.62).

Descriptive Analysis of Agile Co-Creation

Table 7 presents the descriptive statistics for agile co-creation indicators. Customer feedback integration recorded the highest mean (M = 4.22, SD = 0.69), followed by collaborative adaptation (M = 4.05, SD = 0.75). Peer entrepreneurial networking had a mean of 3.99 (SD = 0.73), network-based responsiveness had a mean of 3.91 (SD = 0.81), and flexible response to demand had a mean of 3.87 (SD = 0.79). The aggregate mean for agile co-creation was 4.01 (SD = 0.58).

Table 5. Demographic Distribution of Respondents (n = 220)

Variable	Category	Frequency	Percentage
Age	21–30 years	64	29.1
	31–40 years	80	36.4
	41–50 years	58	26.3
	Above 50 years	18	8.2
Education	Primary Education	31	14.1
	Secondary Education	90	40.9
	Diploma/NCE	60	27.3
	University Degree	24	10.9
	Postgraduate Degree	15	6.8
Years in Business	1–3 years	52	23.6
	4–7 years	84	38.2
	8–10 years	55	25.0
	Above 10 years	29	13.2
Business Sector	Agro-processing & Food Trade	62	28.2
	Retail/Petty Trading	53	24.1
	Fashion & Tailoring	40	18.2
	Food Services & Catering	22	10.0
	Cosmetics/Household Consumables	22	10.0
	Digital/Online Commerce	13	5.9
	Logistics/Support Services	8	3.6

Table 6. Descriptive Statistics for Digital Entrepreneurship Indicators

Indicator	Mean	SD	Rank
WhatsApp Business Use	4.31	0.71	1
Social-Media Marketing	4.08	0.83	2
Mobile Banking Usage	3.96	0.78	3
Digital Payment Adoption	3.88	0.86	4
Online Customer Referrals	3.67	0.92	5
Aggregate Mean	**3.98**	**0.62**	—

Table 7. Descriptive Statistics for Agile Co-Creation Indicators

Indicator	Mean	SD	Rank
Customer Feedback Integration	4.22	0.69	1
Collaborative Adaptation	4.05	0.75	2
Peer Entrepreneurial Networking	3.99	0.73	3
Network-Based Responsiveness	3.91	0.81	4
Flexible Response to Demand	3.87	0.79	5
Aggregate Mean	**4.01**	**0.58**	—

Reliability Analysis

Reliability analysis was conducted using Cronbach's alpha to assess the internal consistency of the two study constructs. The results indicated that digital entrepreneurship had a Cronbach's alpha of .81 across 6 items, while agile co-creation had a Cronbach's alpha of .79 across 5 items. Both coefficients exceeded the .70 threshold commonly accepted in social science research, indicating satisfactory internal consistency for the measurement of both constructs.

Correlation Analysis

Pearson correlation analysis (Table 8) showed a positive correlation between digital entrepreneurship and agile co-creation, $r(218) = .64$, $p < .001$.

Table 8. Correlation Matrix

Variable	DE	ACO
Digital Entrepreneurship (DE)	1	
Agile Co-Creation (ACO)	.64**	1

Note. $p < .001$.

Regression Analysis and Hypothesis Testing

The regression model summary (Table 9) showed $R = .64$, $R^2 = .41$, adjusted $R^2 = .40$, and a standard error of .47.

Table 9. Regression Model Summary

R	R^2	Adjusted R^2	Std. Error
.64	.41	.40	.47

The ANOVA result (Table 10) was significant, $F(1, 218) = 151.84$, $p < .001$.

Table 10. ANOVA Results

Source	SS	df	MS	F	Sig.
Regression	33.48	1	33.48	151.84	< .001
Residual	48.04	218	0.22		
Total	81.52	219			

The regression coefficient for digital entrepreneurship (Table 11) was positive and significant, $\beta = .64$, $t(218) = 12.32$, $p < .001$. The null hypothesis was rejected.

Table 11. Regression Coefficients

Variable	Beta	t-value	Sig.
Digital Entrepreneurship	.64	12.32	< .001

Discussion

Interpretation of Findings

The results show a positive and statistically significant relationship between digital entrepreneurship and agile co-creation among women entrepreneurs in Ashaka Town, with digital entrepreneurship accounting for a substantial share of the variation in agile co-creation. This pattern suggests that digital entrepreneurship in the Ashaka context is not functioning merely as a transactional convenience; rather, it is operating as an organizing logic for how women entrepreneurs communicate, coordinate, and adjust their business practices. The descriptive results further reinforce this interpretation: WhatsApp business use and social-media marketing recorded the highest means among the digital entrepreneurship indicators, while customer feedback integration led the agile co-creation indicators. Taken together, the pattern points to a relational form of digital entrepreneurship grounded in communication, responsiveness, and adaptive exchange. In the uploaded evidence, this is consistent with the view that women entrepreneurs in semi-urban economies use low-cost digital tools for business continuity, customer retention, order coordination, and gradual market expansion rather than for high-end digital transformation

What the findings show, in practical terms, is that digital entrepreneurship in Ashaka is largely built around incremental digital adaptation. The strongest indicators are not advanced e-commerce systems, but mobile-based practices that fit the constraints of a semi-urban economy: messaging customers, receiving transfers, promoting products on social media, and using digital referrals to extend reach. This aligns with the uploaded synthesis of women's digital entrepreneurship in developing economies, which emphasizes that social-media commerce and mobile banking often serve as low-barrier entry points into digital markets, especially where mobility, capital, and formal infrastructure are limited (Franco *et al.*, 2021; Fatima & Ali, 2023; Zarrilli, 2026). The present findings therefore suggest that agile co-creation emerges when women entrepreneurs are able to translate these modest digital tools into collaborative business behaviours, such as adapting offers, incorporating feedback, and coordinating with peers and customers.

The result also implies that agile co-creation is not a separate capability existing after digital entrepreneurship; it is the relational outcome of digital entrepreneurship when digital tools are used in socially embedded ways. In the Ashaka context, co-creation appears to be shaped by customer interaction, peer networking, and flexible business adjustment. The literature reviewed in the uploaded documents shows that women entrepreneurs often use WhatsApp groups, Facebook communities, and informal digital networks as practical spaces for exchange, mutual assistance, and collective problem-solving (Dale *et al.*, 2026; Tarafder *et al.*, 2026). The present result fits that pattern closely. It indicates that when digital entrepreneurship is practiced in a low-cost and socially connected manner, it supports collaborative adaptation rather than isolated business action.

Theoretical Implications

The findings provide support for DCT as the study's guiding framework. DCT explains how firms sense opportunities, seize them, and transform their resource base in response to environmental change. In this study, digital entrepreneurship appears to serve as the mechanism through which women entrepreneurs sense market signals, seize digital opportunities, and transform routine business practices into more responsive and collaborative forms of operation. The positive link between digital entrepreneurship and agile co-creation therefore reflects more than simple technology adoption; it reflects adaptive capability in action. The uploaded synthesis documents consistently frame DCT as the most suitable lens for understanding digital adaptation, collaborative learning, and digitally mediated co-creation among women entrepreneurs in resource-constrained economies.

The result is especially meaningful because the strongest digital practices in the study are not capital-intensive technologies but flexible, accessible tools: mobile banking, social-media commerce, online referrals, and digital payments. Under DCT, these practices can be read as sensing and seizing behaviours. Women entrepreneurs sense customer demand through social media, seize opportunities through mobile-enabled transactions, and transform their business routines through networked responsiveness and collaborative adaptation. This interpretation aligns with the uploaded evidence showing that DCT is particularly useful where environmental uncertainty, digital skill gaps, and informal institutional constraints shape entrepreneurial behaviour (Emembolu *et al.*, 2022). In Ashaka, the theory helps explain why digital entrepreneurship becomes effective not when it is technologically advanced, but when it is strategically flexible and socially embedded.

The findings also extend DCT by showing that co-creation can emerge through small-scale, everyday digital practices rather than formal innovation systems. That matters because it places women entrepreneurs in semi-urban economies within the theoretical conversation about dynamic capabilities without forcing them into an urban high-tech model. The study therefore contributes a localized illustration of DCT in which business flexibility, customer responsiveness, and collaborative adaptation operate through ordinary digital tools rather than through specialized digital infrastructure.

Comparison with Previous Studies

The present findings are broadly consistent with prior studies showing that digital entrepreneurship improves SME performance, efficiency, and customer relations. Franco *et al.* (2021) found that digital entrepreneurship strengthens SME digitalization and management, while Wanzala and Ogechukwu Obokoh (2025) reported that digitalization improves the performance of female-owned SMEs. Mousa *et al.* (2024) similarly observed that women digital entrepreneurs build autonomy and resilience through digital literacy, platform experience, and community networks. The present result extends these studies by focusing on the predictive connection between digital entrepreneurship and agile co-creation rather than only on firm performance. It shows that the performance benefits of digital entrepreneurship may be mediated by collaborative adaptation and customer responsiveness.

The findings also align with studies on social-media commerce and customer engagement. Fatima and Ali (2023) showed that businesswomen use social media to engage customers, while Marolt *et al.* (2022) demonstrated that social media use improves business performance through relational social commerce capabi-

lity. Jiménez-Zarco *et al.* (2021) further linked social-media marketing strategies to brand financial performance among female micro-entrepreneurs. The current study complements these findings by showing that in Ashaka Town, social-media use is not only promotional but also collaborative. It supports feedback integration, peer interaction, and business adjustment, which are core features of agile co-creation.

The digital payments result also sits comfortably with prior research on financial inclusion and resilience. Gupta *et al.* (2025) reported that QR-based payments improve small-business resilience, while Karyotaki *et al.* (2022) highlighted the role of mobiles in sustainable local development for women. Rahayu *et al.* (2023) showed that women entrepreneurs used social media strategically during crisis conditions. The present study is compatible with these studies because it shows that women entrepreneurs in Ashaka use mobile-based and digital financial tools in ways that support flexible adaptation and business continuity. It also resonates with collaborative entrepreneurship literature showing that platform ecosystems, informal networks, and social capital support co-creation and innovation among women entrepreneurs (Dale *et al.*, 2026; Tarafder *et al.*, 2026).

Contextual Interpretation within the Ashaka Economy

Ashaka Town provides a specific semi-urban context in which digital entrepreneurship takes a practical and relational form. The uploaded materials describe an economy shaped by industry, agriculture, petty trade, tailoring, food vending, and women-led microenterprise activity. Within that setting, digital practices are not detached from the local economy; they are woven into it. Women entrepreneurs are likely to use WhatsApp, Facebook, mobile transfers, and POS systems because these tools fit the realities of limited infrastructure, mobility constraints, and informal trading relationships. The present findings therefore make sense within Ashaka's hybrid economic structure, where business survival depends on low-cost adaptability and community-based exchange.

The study also reflects the broader pattern documented in the uploaded Nigeria-focused synthesis: women-owned micro and small enterprises in semi-urban settings navigate infrastructural, gendered, and financial constraints by relying on mobile-enabled practices, social-media commerce, and informal networks. In Ashaka, this means that digital entrepreneurship is likely to remain incremental, relational, and embedded in everyday entrepreneurial routines rather than fully platform-driven or heavily formalized. The finding that digital entrepreneurship predicts agile co-creation therefore captures the logic of the local economy well. It shows that in Ashaka, digital tools do not replace informal collaboration; they intensify and extend it.

Conclusion and Recommendations

Conclusion

This study examined digital entrepreneurship as a predictor of agile co-creation among women entrepreneurs in Ashaka Town, Nigeria. Using a simulation-based quantitative model grounded in literature-informed synthetic data, the study found a positive and statistically significant predictive relationship between digital entrepreneurship and agile co-creation. Women entrepreneurs who demonstrated stronger engagement with mobile-enabled business practices—particularly WhatsApp business use, social-media marketing, mobile banking, and digital payments—also exhibited higher levels of customer feedback integration, collaborative adaptation, and network-based entrepreneurial responsiveness.

The study contributes to the growing literature on women entrepreneurship in developing economies in three important ways. First, it provides localized insight into digital entrepreneurship within a semi-urban northeastern Nigerian context that remains underrepresented in entrepreneurship scholarship. Second, it reframes agile co-creation not as a formal innovation-system activity, but as a practical and socially embedded process emerging through mobile communication, peer interaction, and adaptive customer engagement. Third, the study demonstrates the analytical usefulness of synthetic-data modelling for exploratory entrepreneurship research in under-documented economic environments where formal datasets are limited.

The findings further suggest that digital entrepreneurship in Ashaka is best understood not as sophisticated technological transformation, but as an incremental and relational capability. Women entrepreneurs appear to use accessible digital tools to extend market reach, maintain customer interaction, coordinate transactions, and sustain collaborative business adaptation under conditions of infrastructural and financial constraint. In this sense, digital entrepreneurship functions as a mechanism for entrepreneurial flexibility and socially mediated resilience within the semi-urban economy. The study therefore advances the argument that low-cost digital infrastructures can support collaborative value creation and adaptive entrepreneurship among women-owned micro and small enterprises in resource-constrained settings.

Policy and Practical Recommendations

The findings suggest the need for mobile-first entrepreneurship support strategies in semi-urban economies such as Ashaka. Since WhatsApp business use and social-media marketing emerged as the strongest digital entrepreneurship indicators, government agencies and SME support institutions should prioritize practical digital-commerce training rather than highly technical innovation programmes that may not align with local entrepreneurial realities. Training initiatives should focus specifically on customer engagement, digital marketing, mobile payments, online referrals, and platform-based communication skills.

Government should strengthen enabling infrastructure through improved electricity supply, affordable internet access, and expanded digital connectivity in semi-urban communities. However, beyond infrastructure, policy interventions should support localized digital enterprise ecosystems in which women entrepreneurs can collaborate, share information, and collectively improve market visibility. Such interventions may include community-based digital enterprise clusters, cooperative business networks, and women-focused digital hubs that integrate mentoring, financing, and entrepreneurial support services (Mamabolo & Lekoko, 2021; Thomas, 2024).

Women entrepreneurship agencies and SME development institutions should also design programmes that recognize the relational nature of women's entrepreneurship in Ashaka-like economies. Since customer feedback integration and collaborative adaptation emerged as major dimensions of agile co-creation, entrepreneurship interventions should incorporate peer-learning models, customer-engagement workshops, and collaborative business incubation mechanisms rather than focusing exclusively on individual business ownership.

Telecommunication providers and digital financial institutions should expand low-cost business-oriented services targeted at women-owned microenterprises. Simplified mobile-payment

systems, reduced transaction charges, flexible data plans, and user-friendly digital interfaces may strengthen women's confidence and sustained participation in digital commerce. Existing evidence indicates that mobile-enabled entrepreneurship becomes more sustainable when affordability, accessibility, and trust are integrated into digital financial ecosystems (Gupta *et al.*, 2025; Karyotaki *et al.*, 2022). Consequently, digital inclusion policies should move beyond access alone toward sustained entrepreneurial usability.

Limitations of the Study

The study is exploratory and simulation-based. Its findings derive from literature-informed synthetic survey data rather than direct field responses from women entrepreneurs in Ashaka Town. Consequently, the results should not be interpreted as definitive empirical measurements of actual entrepreneurial behaviour within the town. Nonetheless, the study demonstrates the analytical value of synthetic modelling for generating theoretically grounded insights and testable propositions in contexts where reliable entrepreneurial datasets are limited or difficult to obtain.

Another limitation is the study's deliberately parsimonious design. The model focused primarily on the direct relationship between digital entrepreneurship and agile co-creation and therefore did not incorporate potentially important moderating or mediating variables such as digital literacy, entrepreneurial education, financial inclusion, or socio-cultural constraints. These limitations, however, also create opportunities for future empirical refinement and theoretical expansion.

Suggestions for Further Research

Future studies should validate the present findings through field-based surveys involving actual women entrepreneurs in Ashaka Town and comparable semi-urban communities across northeastern Nigeria. Mixed-method approaches combining surveys, interviews, and digital ethnography would provide deeper insight into how women entrepreneurs experience digital adaptation, collaboration, and customer engagement in everyday business practice.

Comparative regional studies would also be valuable, particularly comparisons between industrial semi-urban economies such as Ashaka and predominantly agrarian communities within northern Nigeria. Such studies may reveal how local economic structures shape patterns of digital entrepreneurship and collaborative adaptation. Longitudinal research is equally important because digital entrepreneurship practices evolve rapidly alongside changes in mobile technology, platform ecosystems, and digital financial inclusion.

Future research should additionally examine mediating and moderating variables that may influence the relationship between digital entrepreneurship and agile co-creation. Variables such as digital trust, entrepreneurial networks, gender norms, financial literacy, platform accessibility, and infrastructural quality may deepen understanding of collaborative entrepreneurial behaviour in resource-constrained economies. Network-analysis approaches focusing specifically on WhatsApp entrepreneurship ecosystems and informal digital business communities may also provide important insights into the relational dynamics of women's entrepreneurship in semi-urban Africa.

In conclusion, the study suggests that within semi-urban entrepreneurial ecosystems such as Ashaka, digital entrepreneurship functions less as technological sophistication and more as a socially embedded capability for collaborative adaptation, incremental innovation, and entrepreneurial resilience among women-owned enterprises.

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