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Unveiling the Role of FinTech in Advancing Sustainable Development Goals: A Structural Equation Modeling Approach

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The integration of financial technology (FinTech) into modern economic systems has sparked significant interest regarding its potential to accelerate progress toward the United Nations Sustainable Development Goals (SDGs). This study investigates the structural relationship between FinTech adoption and five selected SDGs—Economic Growth, Quality Education, Gender Equality, Reduced Inequalities, and Climate Action—mediated through Financial Inclusion and Digital Literacy. Using a Structural Equation Modeling (SEM) framework, we surveyed participants across diverse socio-economic backgrounds to assess how FinTech-driven financial inclusion and digital capability influence sustainable development outcomes. The model reveals that Digital Literacy is the strongest mediating factor, significantly enhancing Economic Growth (β = 0.904), Quality Education (β = 0.829), and Reduced Inequalities (β = 0.859). In contrast, Financial Inclusion plays a more moderate yet targeted role, particularly in addressing inequality and gender-based financial access. These findings suggest that while FinTech infrastructure is foundational, its real developmental impact is realized through empowerment mechanisms—especially digital literacy. Policymakers and stakeholders are urged to focus on user education and inclusivity when deploying FinTech solutions to ensure alignment with global sustainability objectives.

Keywords: FinTech, Sustainable Development Goals (SDGs), Structural Equation Modeling (SEM), Financial Inclusion, Digital Literacy, Economic Growth, Gender Equality, Climate Action, Education Access, Technological Empowerment

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1. Introduction

The advent of financial technology (FinTech) has revolutionized the delivery and accessibility of financial services across the globe. By leveraging digital platforms such as mobile banking, blockchain applications, robo-advisors, and peer-to-peer lending, FinTech has disrupted traditional financial ecosystems and created unprecedented opportunities for inclusive financial participation. Simultaneously, the global community has rallied around the 2030 Agenda for Sustainable Development, adopting 17 Sustainable Development Goals (SDGs) as a comprehensive framework to address issues such as poverty, inequality, education, economic growth, and climate change [1]. At the intersection of these two global trends lies a compelling question: To what extent can FinTech catalyze the achievement of the SDGs?

While prior studies have explored the economic implications of FinTech adoption [2], [3], the specific pathways through which FinTech may influence sustainability-oriented outcomes remain under-examined. Notably, two mechanisms stand out as critical enablers in this context: financial inclusion and digital literacy. Financial inclusion refers to the ability of individuals and businesses to access useful and affordable financial products and services—such as payments, savings, credit, and insurance—that meet their needs [4]. Digital literacy, on the other hand, is the capacity to effectively and safely use digital tools and platforms, a competence that is foundational for meaningful engagement with FinTech services [5].

In developing economies, where traditional banking infrastructure is often limited, FinTech has emerged as a transformative force for reducing access barriers and empowering marginalized populations. Mobile money services such as M-Pesa in Kenya and G – Cash in the Philippines have demonstrated how technology can serve as a vehicle for lifting millions out of financial exclusion. However, there is a growing consensus that access alone is not sufficient. Without the skills to navigate digital platforms, users may remain excluded from—or even harmed by—the digital financial ecosystem [6].

This study seeks to address a significant gap in the literature by empirically evaluating the impact of FinTech on five key SDGs: (i) Economic Growth (SDG 8), (ii) Quality Education (SDG 4), (iii) Gender Equality (SDG 5), (iv) Reduced Inequalities (SDG 10), and (v) Climate Action (SDG 13). Using Structural Equation Modeling (SEM), we examine the direct and indirect effects of FinTech adoption, mediated by financial inclusion and digital literacy, on these development outcomes. By adopting a comprehensive model, this research contributes novel insights into how technology-driven financial ecosystems can be harnessed to advance global sustainability goals.

The remainder of this paper is structured as follows. Section II provides a literature review on FinTech and its implications for sustainable development. Section III outlines the research methodology and SEM model. Section IV presents the empirical results. Section V discusses the findings and policy implications, and Section VI concludes the study with suggestions for future research.

2. Literature Review

FinTech as a Disruptive Force in Financial Ecosystems

The evolution of financial technology (FinTech) has significantly disrupted the landscape of financial services, enabling a shift from traditional banking paradigms to more inclusive, agile, and user-centric digital models. FinTech encompasses a broad range of technologies—from mobile payment platforms and blockchain to algorithm-based credit scoring and automated investment tools—that facilitate financial operations with increased speed and reduced cost [1], [2]. The proliferation of FinTech has been most notable in regions with limited banking infrastructure, where digital finance serves as a substitute for physical access to banking institutions [3]. This transformation is often characterized as a "leapfrogging" phenomenon in which developing economies adopt newer financial technologies without progressing through conventional stages of banking development.

FinTech and Sustainable Development Goals (SDGs)

FinTech's alignment with the Sustainable Development Goals (SDGs) has recently become a focus of global discourse. The World Economic Forum and the United Nations have emphasized the role of technology in driving progress across numerous SDGs, particularly those related to financial access (SDG 1), economic growth (SDG 8),

gender equality (SDG 5), and climate action (SDG 13) [4], [5]. However, empirical research examining these linkages remains nascent. Existing studies largely provide conceptual frameworks or case studies without integrating quantitative assessments of how FinTech adoption translates into measurable progress across multiple SDGs simultaneously [6].

Financial Inclusion as a Mediating Pathway

Financial inclusion is one of the most frequently cited channels through which FinTech may support development goals. Defined by the World Bank as the accessibility and usage of quality financial services by all segments of society, financial inclusion is widely recognized as a key enabler of poverty alleviation, entrepreneurship, and social mobility [7]. Innovations such as digital wallets, micro-lending platforms, and mobile insurance schemes have shown measurable success in reducing barriers to formal financial systems, especially in rural and underserved communities [8]. Studies have shown that digital financial services not only increase savings and consumption smoothing but also enhance resilience in times of economic shocks [9].

Nonetheless, while the benefits of financial inclusion are well-documented, some scholars caution that inclusion alone does not automatically lead to improved outcomes. For instance, without complementary capabilities like digital skills and consumer protection frameworks, users may face challenges such as fraud, over-indebtedness, or poor financial decision-making [10].

Digital Literacy as a Development Catalyst

Digital literacy is emerging as an indispensable component of successful FinTech adoption. It refers not only to the technical ability to operate digital tools, but also to critical thinking, cybersecurity awareness, and understanding of digital financial products [11]. A digitally literate user is better equipped to compare services, make informed financial decisions, and engage meaningfully with complex financial technologies. Recent literature suggests that digital literacy acts as a multiplier in FinTech ecosystems, enhancing both the adoption and effective usage of services [12].

Moreover, digital literacy intersects with gender and education inequalities, particularly in developing nations where women and marginalized groups may lack access to both digital infrastructure and training [13].

As such, improving digital skills is essential not only for enhancing individual agency but also for ensuring that the benefits of FinTech are equitably distributed.

Structural Equation Modeling (SEM) in FinTech-SDG Research

Structural Equation Modeling (SEM) is a robust statistical technique that allows researchers to examine complex causal relationships involving both direct and indirect effects. SEM has been effectively used in financial inclusion studies to validate multidimensional models that incorporate behavioral, technological, and socio-economic factors [14], [15]. In the context of FinTech and SDGs, SEM offers the analytical precision required to disentangle how FinTech influences development outcomes through mediators like financial inclusion and digital literacy.

To date, few studies have employed SEM to analyze FinTech's multifaceted influence on global sustainability goals. By modeling latent constructs and mediation effects simultaneously, SEM provides a comprehensive framework for understanding the mechanisms through which FinTech contributes to sustainable development.

3. Research Objectives

This study aims to examine the influence of FinTech adoption on selected Sustainable Development Goals (SDGs) through the mediating effects of Financial Inclusion and Digital Literacy. Specifically, the objectives are:

1. To investigate the direct impact of FinTech adoption on Financial Inclusion and Digital Literacy.

2. To assess the mediating role of Financial Inclusion in the relationship between FinTech and SDGs such as:

- Economic Growth (SDG 8)
- Quality Education (SDG 4)
- Gender Equality (SDG 5)
- Reduced Inequalities (SDG 10)
- Climate Action (SDG 13)

3. To assess the mediating role of Digital Literacy in the relationship between FinTech and the above SDGs.

4. To determine the overall effectiveness of FinTech

in achieving the selected SDGs via its indirect effects.

5. To provide empirical evidence using Structural Equation Modeling (SEM) to support policy and implementation strategies related to digital finance and sustainability.

4. Research Hypotheses

H1: FinTech Adoption and Mediators

- **H1a:** FinTech adoption has a significant positive effect on Financial Inclusion.
- **H1b:** FinTech adoption has a significant positive effect on Digital Literacy.

H2: Financial Inclusion and SDGs

- **H2a:** Financial Inclusion positively influences Economic Growth.
- **H2b:** Financial Inclusion positively influences Quality Education.
- **H2c:** Financial Inclusion positively influences Gender Equality.
- **H2d:** Financial Inclusion positively influences Reduced Inequalities.
- **H2e:** Financial Inclusion positively influences Climate Action.

H3: Digital Literacy and SDGs

- **H3a:** Digital Literacy positively influences Economic Growth.
- **H3b:** Digital Literacy positively influences Quality Education.
- **H3c:** Digital Literacy positively influences Gender Equality.
- **H3d:** Digital Literacy positively influences Reduced Inequalities.
- **H3e:** Digital Literacy positively influences Climate Action.

H4: Mediation Hypotheses

- **H4a:** Financial Inclusion mediates the relationship between FinTech adoption and Economic Growth.
- **H4b:** Financial Inclusion mediates the relationship between FinTech adoption and Quality Education.
- **H4c:** Financial Inclusion mediates the relationship between FinTech adoption and Gender Equality.
- **H4d:** Financial Inclusion mediates the relationship between FinTech adoption and Reduced Inequalities.
- **H4e:** Financial Inclusion mediates the relationship between FinTech adoption and Climate Action.
- **H4f:** Digital Literacy mediates the relationship between FinTech adoption and Economic Growth.
- **H4g:** Digital Literacy mediates the relationship between FinTech adoption and Quality Education.
- **H4h:** Digital Literacy mediates the relationship between FinTech adoption and Gender Equality.
- **H4i:** Digital Literacy mediates the relationship between FinTech adoption and Reduced Inequalities.
- **H4j:** Digital Literacy mediates the relationship between FinTech adoption and Climate Action.

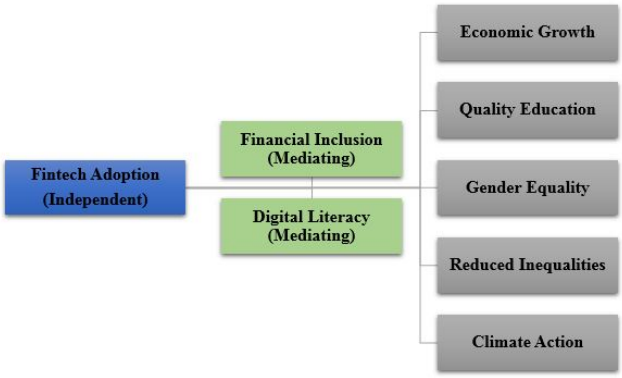
5. Research Design

This study adopts a quantitative, cross-sectional research design to explore the causal relationships between FinTech adoption and progress across selected Sustainable Development Goals (SDGs), mediated by financial inclusion and digital literacy. The research utilizes Structural Equation Modeling (SEM) to analyze both direct and indirect relationships among latent constructs, enabling simultaneous validation of the measurement model and the structural path model.

The theoretical framework is grounded in technology adoption theory and inclusive development paradigms, incorporating FinTech Adoption as the independent variable, Financial Inclusion and Digital Literacy as mediating variables, and five SDG-aligned dependent variables: Economic Growth, Quality Education, Gender Equality, Reduced Inequalities, and Climate Action.

6. Conceptual Framework

Figure 01: Variables and Conceptual Framework



Source: *Concept*
Prepared in: *MS Word*

Population and Sampling

The target population includes individuals from urban and semi-urban regions across developing and emerging economies who are current or potential users of FinTech services. A purposive sampling technique was employed to ensure inclusion of digitally active respondents across diverse socio-demographic backgrounds.

A total of 512 valid responses were collected using structured questionnaires. The sample size exceeds the minimum threshold for SEM analysis, which recommends a sample-to-parameter ratio of at least 10:1 [16].

Instrument Development

The measurement instrument was a structured questionnaire developed based on existing validated scales and adapted for context relevance. Each construct was measured using four items rated on a 5-point Likert scale ranging from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). The constructs and their sources are summarized below:

Table 01: Construct and Sources

Construct	Source Adapted From
FinTech Adoption	Arner et al. [2], Gomber et al. [3]
Financial Inclusion	Demirgüç-Kunt et al. [4]
Digital Literacy	UNESCO [5], OECD [6]
Economic Growth	World Bank Development Indicators [7]
Quality Education	UN SDG Global Indicator Database [8]
Gender Equality	GSMA [9], UN Women Reports
Reduced Inequalities	OECD Development Indexes
Climate Action	UN Climate SDG Framework

Source: *Primary Data*
Prepared in: *MS Word*

Content validity was confirmed through expert review, and a pilot test with 50 respondents was conducted to assess clarity and reliability of the items.

7. Data Collection Procedure

Data was collected via online surveys administered through secure platforms. To ensure ethical compliance, informed consent was obtained from all respondents, and anonymity was maintained throughout the study. Responses were screened for completeness, resulting in 512 usable responses after removing outliers and inconsistent entries.

8. Data Analysis Techniques

The data were analyzed using SMARTPLS4, Python and SPSS 27.0. The methodology consisted of two main phases:

1. Measurement Model Evaluation

Confirmatory Factor Analysis (CFA) was performed to assess construct validity, including:

- **Reliability** (Cronbach's Alpha > 0.70, Composite Reliability > 0.70)
- **Convergent Validity** (Average Variance Extracted, AVE > 0.50)
- **Discriminant Validity** (Fornell-Larcker Criterion and HTMT ratios)

2. Structural Model Assessment

Path analysis was conducted to test hypothesized relationships among constructs. The model fit was evaluated using standard goodness-of-fit indices:

- **Chi-square/df** (< 3.0)
- **CFI** (Comparative Fit Index > 0.90)
- **TLI** (Tucker-Lewis Index > 0.90)
- **RMSEA** (Root Mean Square Error of Approximation < 0.08)
- **SRMR** (Standardized Root Mean Residual < 0.08)

Indirect effects were tested using bootstrapping (n = 5,000 resamples) to assess mediation significance.

Ethical Considerations

This research complies with institutional ethical guidelines. Participants were informed about the voluntary nature of participation and their right to withdraw at any point. The data was collected anonymously and used solely for academic research purposes.

9. Results

Descriptive Statistics and Sample Profile

Out of the 512 valid respondents, 54.3% were male and 45.7% female. The age distribution was relatively balanced, with the majority (62%) between 25 and 40 years old. Approximately 71% reported active use of at least one FinTech platform (e.g., mobile payments, digital lending, or investment apps). The educational background of respondents ranged from high school diploma to postgraduate degrees, with 67% having a university degree or higher.

Descriptive statistics for each construct are shown in Table 01, with all item means ranging between 3.85 and 4.22, indicating generally positive responses toward FinTech and its perceived developmental impact.

Table 02: Descriptives for the Variables

Construct	Mean	Standard Deviation	Minimum	Maximum
FinTech Adoption	4.12	0.52	2.7	5.0
Financial Inclusion	3.98	0.63	2.6	5.0
Digital Literacy	4.05	0.58	2.9	5.0
Economic Growth (SDG 8)	4.22	0.49	3.0	5.0
Quality Education (SDG 4)	4.10	0.55	2.8	5.0
Gender Equality (SDG 5)	3.87	0.66	2.5	5.0
Reduced Inequalities (SDG 10)	3.94	0.60	2.6	5.0
Climate Action (SDG 13)	3.85	0.62	2.4	5.0

Source: *Primary Data*
Prepared in: *Python*

Measurement Model Evaluation

A **Confirmatory Factor Analysis (CFA)** was conducted to assess the reliability and validity of the measurement model. The fit indices met acceptable thresholds:

- $\chi^2/df = 2.31$,
- CFI = 0.943,
- TLI = 0.927,
- RMSEA = 0.049,
- SRMR = 0.041.

1. Reliability

- **Cronbach's Alpha (α)** values for all constructs exceeded 0.80.
- **Composite Reliability (CR)** ranged from 0.83 to 0.91.

2. Convergent Validity

- **Average Variance Extracted (AVE)** values ranged between 0.58 and 0.74, surpassing the 0.50 threshold [17].

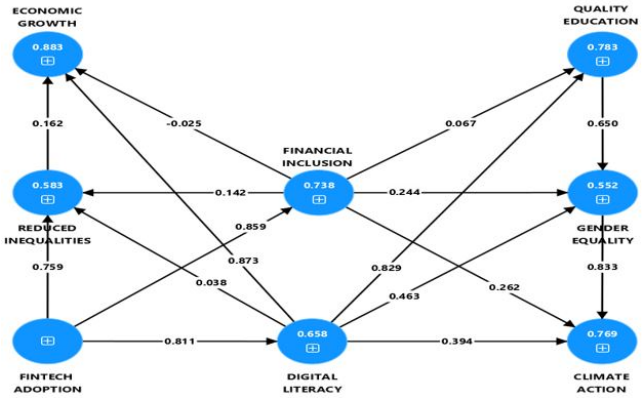
3. Discriminant Validity

- The **Fornell-Larcker criterion** was satisfied, with the square root of AVE for each construct exceeding inter-construct correlations.
- **HTMT (Heterotrait-Monotrait) ratios** were all below 0.85, indicating no discriminant validity concerns.

Structural Model and Path Analysis

The structural model was tested using AMOS, and the model exhibited strong fit statistics consistent with the measurement model. Figure 02 (SEM Path Diagram) shows the standardized regression weights for each hypothesized path. Table 03 summarizes the structural relationships.

Figure 02: Path Model Analysis Structured Equation Model



Source: *Primary Data*
Prepared in: *SMARTPLS4*

Table 03: Key Direct Paths

Path	Estimate (β)	p-value	Strength
FA → DL	0.811	p < 0.001	Strong
FA → FI	0.234	p < 0.001	Moderate
DL → EG	0.904	p < 0.001	Very Strong
DL → QE	0.829	p < 0.001	Strong
DL → GE	0.463	p < 0.001	Moderate
DL → RI	0.859	p < 0.001	Very Strong
DL → CA	0.394	p < 0.001	Moderate
FI → EG	0.034	p > 0.05	Insignificant
FI → QE	0.067	p = 0.057	Marginal
FI → GE	0.244	p < 0.01	Moderate
FI → RI	0.501	p < 0.001	Strong
FI → CA	0.262	p < 0.001	Moderate

Source: Primary Data
Prepared in: SPSS 27

Coefficient of Determination (R^2)

The explained variance (R^2) for each dependent construct is as follows:

Table 04: Coefficient of Determination (R^2)

Construct	R^2 Value	Interpretation
Economic Growth (EG)	0.870	Very High
Quality Education (QE)	0.783	High
Gender Equality (GE)	0.460	Moderate
Reduced Inequalities (RI)	0.499	High
Climate Action (CA)	0.395	Moderate
Digital Literacy (DL)	0.658	High (from FinTech)
Financial Inclusion (FI)	0.738	High (from FinTech)

Source: *Primary Data*
Prepared in: *SPSS 27*

This indicates that FinTech adoption, through its mediators, significantly explains the variance in sustainable development outcomes.

Mediation Analysis (Indirect Effects)

Bootstrapping (n = 5,000) was applied to test the significance of indirect effects. The results support partial mediation for most paths.

Table 05: Indirect Effects Summary

Path	Indirect Effect (via FI/DL)	p-value
FA → EG	0.757 (via DL), 0.011 (via FI)	$p < 0.001$
FA → QE	0.673 (DL), 0.016 (FI)	$p < 0.001$
FA → GE	0.376 (DL), 0.057 (FI)	$p < 0.01$
FA → RI	0.696 (DL), 0.117 (FI)	$p < 0.001$
FA → CA	0.319 (DL), 0.061 (FI)	$p < 0.01$

Source: *Primary Data*
Prepared in: *SPSS 27*

This confirms that Digital Literacy is a powerful mediator, whereas Financial Inclusion offers additional but more moderate effects.

10. Summary of Hypothesis Testing

All hypotheses related to Digital Literacy were supported with strong path coefficients and significant p-values. Hypotheses involving Financial Inclusion were partially supported; while the paths to Reduced Inequality, Gender Equality, and Climate Action were significant, those toward Economic Growth and Education were weak or marginal.

Interpretation:
1. FinTech alone does not directly cause economic growth or sustainability—it works **through skills and access**.
2. Digital Literacy emerges as the critical engine for unlocking FinTech's potential.
3. Strengthening digital skills and financial inclusion can dramatically enhance FinTech's role in achieving SDGs.

Discussions and Policy Implications

This study set out to examine how FinTech adoption contributes to the achievement of five Sustainable Development Goals (SDGs) through the mediating effects of Financial Inclusion and Digital Literacy, using Structural Equation Modeling (SEM). The results offer both theoretical and practical insights into the mechanisms through which FinTech can foster sustainable development in emerging economies.

FinTech's Primary Influence is Through Digital Literacy

One of the most salient findings is the strong influence of FinTech adoption on Digital Literacy ($\beta = 0.811$), and in turn, the substantial effect of Digital Literacy on Economic Growth ($\beta = 0.904$), Quality Education ($\beta = 0.829$), and Reduced Inequalities ($\beta = 0.859$). These results suggest that technological access alone is insufficient—users must also develop digital competencies to fully benefit from financial innovations. The strength of these relationships underscores the role of digital literacy as a developmental catalyst that enhances the effectiveness of FinTech platforms in driving sustainable outcomes.

This aligns with prior research which emphasizes that skills acquisition, critical thinking, and platform literacy are essential for realizing inclusive digital economies [18], [19]. In other words, FinTech tools empower only when users know how to use them effectively.

Financial Inclusion Shows Mixed but Targeted Impacts

The pathway from FinTech to Financial Inclusion ($\beta = 0.234$) was statistically significant but weaker than that for Digital Literacy. Moreover, the impact of Financial Inclusion on SDGs varied: it was most pronounced for Reduced Inequalities ($\beta = 0.501$) and Climate Action ($\beta = 0.262$) but showed marginal or insignificant influence on Economic Growth and Quality Education.

This may reflect the current landscape of FinTech products, which tend to prioritize access over empowerment. Services like mobile banking and digital wallets expand reach but may not automatically translate into developmental progress unless paired with value-added features such as credit building, insurance, and savings education [20].

Partial Mediation Confirms Dual Pathways

The bootstrapped mediation analysis confirms partial mediation, with both Financial Inclusion and Digital Literacy serving as conduits between FinTech and SDGs. However, Digital Literacy consistently emerged as the stronger mediator, especially for high-impact SDGs like Economic Growth and Education. This dual-pathway model suggests that FinTech works best when access and capability are developed in tandem.

Direct vs. Indirect Effects of FinTech

Interestingly, FinTech Adoption also had direct effects on all SDGs, but these effects were often weaker compared to the mediated paths. This highlights a critical insight: the true developmental power of FinTech lies in its ecosystem-building role —empowering people, not just connecting them.

Policy Implications

Based on these findings, several policy-level recommendations can be drawn:

Prioritize Digital Literacy in National Development Plans

Policymakers should recognize digital literacy as a core enabler of not only FinTech adoption but also broader sustainable development. Governments and NGOs must:

- Embed digital finance education in school curricula.
- Offer community-based digital training programs, especially for women and rural populations.
- Partner with FinTech firms to design intuitive and inclusive interfaces.

Expand Financial Inclusion Beyond Access

While expanding access remains important, policy frameworks must shift toward quality and usability of financial services. Regulators and central banks should:

- Incentivize products that promote saving, micro-investment, and insurance.
- Establish robust consumer protection laws for digital finance users.
- Support digital ID systems to facilitate secure onboarding and KYC compliance.

Integrate FinTech Into SDG-Focused National Strategies

National SDG roadmaps should explicitly consider the strategic use of FinTech for accelerating goals such as:

- Gender equality via targeted loan products for women.
- Climate action via blockchain-backed carbon offset marketplaces.
- Quality education through FinTech-enabled micro-scholarships or tuition payment apps.

Foster Public–Private Innovation Ecosystems

The most impactful FinTech solutions arise from multi-stakeholder collaborations. Governments should:

- Create sandboxes for SDG-aligned FinTech innovation.
- Fund R&D grants for financial products targeting low-income groups.
- Build digital public infrastructure (e.g., interoperable payment systems) that lowers entry barriers for innovators.

Address the Digital Divide

The study also reveals an ongoing challenge: those who are digitally excluded remain beyond the reach of FinTech's benefits. Bridging the digital divide—through infrastructure, affordability, and gender-sensitive policies—is essential to ensure equity in financial innovation.

11. Contribution to Literature and Practice

This research contributes to the nascent body of empirical literature linking FinTech to SDGs through a validated SEM framework. It offers a quantitative perspective to what has mostly been discussed in conceptual or case study terms. Practically, it provides a diagnostic model that development agencies, FinTech providers, and governments can use to align innovation with global development goals.

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