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ORIGINAL

Digital Financial Literacy and Technology Adoption for Strengthening Financial Inclusion and MSMEs' Performance in Banten, Indonesia

Alfabetización Financiera Digital y Adopción de Tecnología para Fortalecer la Inclusión Financiera y el Desempeño de las MIPYMEs en Banten, Indonesia

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ABSTRACT

Introduction: micro, small, and medium enterprises (MSMEs) in Banten Province, Indonesia, face persistent challenges in financial literacy and the adoption of financial technology (FinTech). Limited access to formal financial services and low levels of financial knowledge constrain their capacity to achieve sustainable growth and resilience in the digital economy.
Objective: this study investigates the influence of financial literacy and FinTech adoption on the financial performance of MSMEs, considering financial inclusion, risk management, and financial decision-making behavior as mediating variables.
Method: a mixed-method design was applied, combining survey data from 150 MSME owners with in-depth interviews and focus group discussions involving key stakeholders. Structural Equation Modeling (SEM) was employed to test both direct and indirect relationships among variables.
Results: Findings demonstrate that financial literacy significantly improves MSMEs' access to and utilization of formal financial services, thereby strengthening financial performance. Financial inclusion emerged as a key mediating factor linking financial literacy and FinTech adoption with business outcomes. The use of FinTech tools facilitates efficiency, access to innovative services, and sustainable business practices, though these benefits depend on adequate digital financial literacy.
Conclusion: strengthening financial literacy and advancing inclusive FinTech infrastructure are essential strategies to empower MSMEs. These interventions are crucial for enhancing financial resilience, competitiveness, and sustainable development within an increasingly technology-driven economy.

Keywords: Financial Literacy; FinTech; Inclusion; Sustainable Development.

RESUMEN

Introducción: las micro, pequeñas y medianas empresas (MIPYMEs) de la provincia de Banten, Indonesia, enfrentan desafíos persistentes relacionados con la alfabetización financiera y la adopción de tecnología financiera (FinTech). El acceso limitado a los servicios financieros formales y los bajos niveles de conocimiento financiero restringen su capacidad de lograr un crecimiento sostenible y resiliencia en la economía digital.
Objetivo: este estudio examina la influencia de la alfabetización financiera y la adopción de FinTech en

el desempeño financiero de las MIPYMEs, considerando la inclusión financiera, la gestión de riesgos y el comportamiento de toma de decisiones financieras como variables mediadoras.
Método: se aplicó un diseño de métodos mixtos, que combinó datos de encuestas a 150 propietarios de MIPYMEs con entrevistas en profundidad y grupos focales con actores clave. Se utilizó el Modelo de Ecuaciones Estructurales (SEM) para analizar las relaciones directas e indirectas entre las variables.
Resultados: los hallazgos demuestran que la alfabetización financiera mejora significativamente el acceso y el uso de los servicios financieros formales, fortaleciendo así el desempeño financiero. La inclusión financiera emergió como un factor mediador esencial, vinculando la alfabetización financiera y la adopción de FinTech con los resultados empresariales. El uso de herramientas FinTech facilita la eficiencia, el acceso a servicios innovadores y prácticas empresariales sostenibles, aunque estos beneficios dependen de una base sólida de alfabetización financiera digital.
Conclusión: fortalecer la alfabetización financiera y desarrollar una infraestructura inclusiva de FinTech son estrategias fundamentales para empoderar a las MIPYMEs. Estas intervenciones son cruciales para mejorar la resiliencia financiera, la competitividad y el desarrollo sostenible en una economía cada vez más impulsada por la tecnología.

Palabras clave: Educación Financiera; Tecnología Financiera; Inclusión; Desarrollo Sostenible.

INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) are a cornerstone of global socio-economic development, generating approximately 60 % of global GDP and more than 70 % of total employment worldwide.[1,2] In Indonesia, MSMEs represent 99,8 % of all enterprises and contributed 57,8 % to Gross Regional Domestic Product (GRDP) in Banten Province in 2023.[3] Despite their central role, MSMEs continue to face structural barriers—particularly low financial literacy, limited adoption of financial technology (fintech), and restricted access to inclusive financial systems. These constraints undermine their competitiveness and weaken resilience, especially during global disruptions such as the COVID-19 pandemic.

Digital transformation, particularly through fintech innovation, has emerged as a critical driver of business efficiency, innovation, and inclusion. Mobile banking, QR payments, crowdfunding, electronic invoicing, and marketplace integration have shown global potential to reduce transaction costs, enhance transparency, expand access to credit, and strengthen liquidity management.[4,5,6] For MSMEs, fintech adoption offers more than just technological convenience—it becomes a pathway to sustainable growth, integration into digital trade ecosystems, and improved financial performance.

The relationship between fintech adoption and MSME performance can be better understood through theoretical lenses such as the Resource-Based View (RBV) and the Technology Acceptance Model (TAM). The RBV suggests that intangible assets like financial literacy and technological capability are strategic resources that drive competitive advantage. Meanwhile, TAM emphasizes perceived usefulness and ease of use as key determinants in technology adoption—highlighting the importance of literacy and digital readiness in shaping behavioral intention. These frameworks suggest that fintech adoption will yield optimal outcomes only when supported by sufficient knowledge, motivation, and enabling environments.[7,8,9]

In Banten Province, however, these enabling factors remain limited. Only 23,4 % of MSMEs access formal financial services, while financial literacy lags behind national averages; many entrepreneurs continue to face challenges in budgeting, credit management, and cash flow.[10,11] Fintech usage is similarly low: only 28,7 % of MSMEs use digital payments, 15,2 % utilize financial management applications, and a mere 9,3 % engage with alternative lending platforms.[12,13] These gaps underline the urgent need for integrated strategies that combine capacity-building in financial literacy with accelerated digital adoption—grounded in inclusive financial ecosystems and informed by proven theoretical frameworks.

Specifically, the study addresses the following research questions:

1. Does financial literacy enhance financial inclusion and improve MSME performance?
2. Does fintech adoption, including e-commerce integration, expand financial inclusion and strengthen MSME performance?
3. Does financial inclusion mediate the relationship between literacy, fintech adoption, and financial outcomes?

The hypotheses formulated are as follows:

- H1: Financial literacy positively influences financial inclusion.
- H2: Fintech adoption positively influences financial inclusion.
- H3: Financial literacy positively influences MSME financial performance.
- H4: Fintech adoption positively influences MSME financial performance.

- H5: Financial inclusion positively influences MSME financial performance.
- H6: Financial inclusion mediates the effect of financial literacy on performance.
- H7: Financial inclusion mediates the effect of fintech adoption on performance.

METHOD

This study employed a quantitative research design to investigate the relationships among financial literacy, financial technology (fintech) adoption, financial inclusion, and the financial performance of Micro, Small, and Medium Enterprises (MSMEs) in Banten Province, Indonesia. A structured survey was used as the primary data collection instrument, enabling the measurement of constructs through validated indicators. The quantitative approach facilitated statistical testing of hypotheses, ensuring objectivity, reliability, and generalizability of the findings. This design was particularly appropriate for examining the causal relationships among variables in the context of a rapidly evolving digital financial ecosystem.

Research Location and Period

The study was conducted in Banten Province, covering eight districts and cities that represent areas with the highest concentration of MSMEs. Data collection occurred over a six-month period (January–June 2025). Both urban and rural settings were included to reflect variation in digital infrastructure, connectivity, and access to financial services, ensuring representativeness across socio-economic contexts.

Population and Sample

Using stratified random sampling, 150 valid responses were obtained from 180 distributed questionnaires, achieving an 83 % response rate. This sample size meets the adequacy criteria for Structural Equation Modeling-Partial Least Squares (SEM-PLS), satisfying both the “10-times rule” and the inverse square root method for ensuring sufficient statistical power. Moreover, methodological literature emphasizes that a sample size between 100 and 200 cases is generally recommended as a robust starting point for PLS-SEM analysis, ensuring reliable parameter estimation and model convergence.(14)

Data Collection

Quantitative Data: Structured questionnaires adapted from validated instruments were used to measure financial literacy, fintech adoption, financial inclusion, and financial performance. Questionnaires were distributed in hybrid mode—onsite and online (Google Forms)—to accommodate varying levels of digital readiness.(14) A pilot test was conducted prior to the main survey to refine clarity and reliability. Respondents provided informed consent, with confidentiality assured.

Qualitative Data: In-depth interviews and Focus Group Discussions (FGDs) were conducted with MSME owners and local stakeholders.(15) These sessions explored perceptions, barriers, and expectations regarding digital financial services and inclusion, providing a nuanced understanding of contextual dynamics.

Data Analysis

Quantitative Analysis: SEM-PLS was employed to examine both direct and mediating relationships among financial literacy, fintech adoption, financial inclusion, and MSME financial performance. This technique is suitable for analyzing complex models with latent constructs.(16)

Qualitative Analysis: Interview and FGD transcripts were analyzed thematically, identifying patterns related to technological adoption, literacy gaps, and inclusion challenges. Insights from qualitative data were used to support, explain, and contextualize quantitative results.(17)

Ethical Considerations

Ethical approval was obtained from the university’s ethics committee. Participation was voluntary, informed consent was secured, and respondents were assured of data confidentiality and the right to withdraw at any stage.(18)

To evaluate convergent validity and construct reliability, the values of Average Variance Extracted (AVE) and Composite Reliability (CR) were computed. AVE reflects the proportion of variance explained by each construct relative to measurement error, while CR assesses the internal consistency of the indicators within each construct.(19) Table 1 presents the detailed results.

As shown in table 2, all AVE values exceed the recommended threshold of 0,50, confirming adequate convergent validity. Likewise, the Composite Reliability (CR) values for all constructs are above 0,90, which indicates a very high level of internal consistency. These results demonstrate that the measurement instruments are both theoretically sound and empirically reliable, ensuring that the constructs—financial literacy, financial technology adoption, financial inclusion, and MSME financial performance—are measured consistently and accurately within the context of digital transformation and inclusive economic development.

Table 1. Operational Definition

Construct	Operational Definition	Dimensions	Example Items	Scale	Type (PLS-SEM)
Financial Literacy	The capability of MSME owners to understand, manage, and apply financial knowledge to support sustainable business decision-making.	1) Knowledge of financial products and services 2) Budgeting and resource allocation 3) Strategic financial planning	"I am able to compare and select financial products that best support my business needs."	Likert 1-5	Reflective
Fintech Adoption	The extent to which MSMEs integrate digital financial technologies to enhance efficiency, transparency, and competitiveness.	1) Usage frequency of digital platforms 2) Perceived usefulness in operations 3) Ease of integration with business processes	"I regularly use digital payment and online lending applications to improve business operations."	Likert 1-5	Reflective
Financial Inclusion	The degree of access to and effective utilization of formal and digital financial services by MSMEs, enabling equitable participation in the economy.	1) Availability of financial and digital services 2) Accessibility across locations and platforms 3) Effective utilization for business growth	"I can easily access financial services (banks, fintech) when my business needs capital."	Likert 1-5	Reflective
MSME Financial Performance	The measurable financial outcomes of MSME operations in terms of sustainability, growth, and investment capacity.	1) Revenue stability over time 2) Profitability improvement 3) Investment and reinvestment capacity	"My business revenue has remained stable and has shown growth over the past year."	Likert 1-5	Reflective
Decision-Making Behavior *(optional)*	The process through which MSME owners evaluate risks, seek information, and apply analytical reasoning in financial and technological choices.	1) Risk management orientation 2) Information-seeking and evaluation 3) Analytical and data-driven decision-making	"I carefully analyze digital and financial risks before deciding on new technologies or borrowing."	Likert 1-5	Formative

Table 2. Convergent Validity and Reliability Indicators

Construct	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
Financial Literacy	0,903	0,923	0,634
MSME Financial Performance	0,954	0,959	0,630
Financial Inclusion	0,975	0,979	0,852
Financial Technology Adoption	0,975	0,979	0,837
Source: SEM-PLS Data Analysis (2025)			

RESULT

The structure of the relationship between latent constructs and their indicators is examined through the outer model, as illustrated in figure 1. The figure demonstrates the measurement model, showing the loading values of each indicator on its corresponding construct. This visualization is important because it provides evidence of indicator reliability and construct validity, confirming whether the observed variables appropriately represent the latent constructs.

To examine the structural relationships among the proposed constructs, hypothesis testing was performed using path coefficient estimates, t-statistics, and significance levels (P-values). This analytical approach not only validates the robustness of the model but also highlights the critical role of digital transformation, technological innovation, and financial inclusion in shaping MSME financial performance and broader socio-economic development. The detailed outcomes of the hypothesis testing are summarized in table 3.

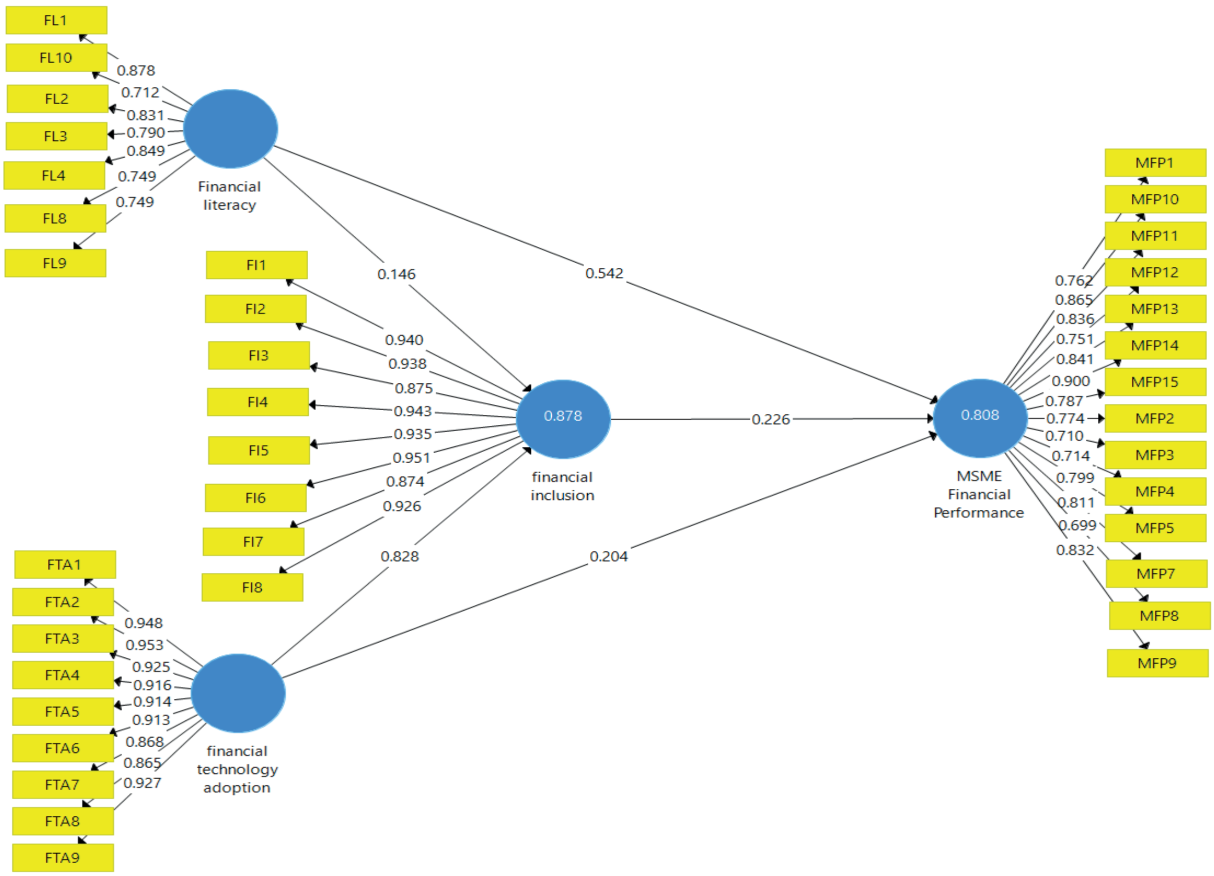

Figure 1. Outer model analysis

Table 3. Results of Hypothesis Testing (Bootstrapping)

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
H1: Financial literacy -> financial inclusion	0,146	0,137	0,069	2,118	0,035
H2: financial technology adoption -> financial inclusion	0,828	0,837	0,064	12,978	0,000
H3: Financial literacy -> MSME Financial Performance	0,542	0,548	0,066	8,206	0,000
H4: financial technology adoption -> MSME Financial Performance	0,204	0,202	0,093	2,194	0,029
H5: financial inclusion -> MSME Financial Performance	0,226	0,224	0,106	2,130	0,034
H6: Financial literacy -> financial inclusion -> MSME Financial Performance	0,033	0,032	0,023	1,435	0,151
H7: financial technology adoption -> financial inclusion -> MSME Financial Performance	0,187	0,186	0,089	2,092	0,037

Source: data analysis SEM Pls 2025

Interpretation of Results:

1. H1 Supported: Financial literacy has a significant positive effect on financial inclusion ($\beta = 0,146$, $p < 0,05$). MSME owners with stronger financial knowledge demonstrate greater utilization of formal financial services, confirming that literacy enhances inclusion.
2. H2 Supported: Fintech adoption strongly and significantly influences financial inclusion ($\beta = 0,828$, $p < 0,001$). The effect size is the largest among all paths, indicating that digital platforms substantially expand access to financial services across diverse business segments.
3. H3 Supported: Financial literacy positively affects MSME financial performance ($\beta = 0,542$, $p <$

0,001). Literate entrepreneurs are better equipped to manage resources, reduce risks, and improve revenue sustainability.

4. H4 Supported: Fintech adoption has a positive and significant effect on financial performance ($\beta = 0{,}204$, $p < 0{,}05$). While the effect is smaller compared to literacy, digital tools such as e-wallets, online lending, and digital bookkeeping contribute to improved efficiency and competitiveness.
5. H5 Supported: Financial inclusion positively impacts MSME financial performance ($\beta = 0{,}226$, $p < 0{,}05$). Greater access to financial services supports profitability, investment capacity, and resilience.
6. H6 Not Supported: The indirect effect of financial literacy on MSME financial performance through financial inclusion is small and not statistically significant ($\beta = 0{,}033$, $p = 0{,}151$). This indicates that while financial literacy directly enhances performance, its mediating pathway via financial inclusion does not play a significant role in this model.
7. H7 Supported: Financial inclusion also mediates the relationship between fintech adoption and financial performance ($\beta = 0{,}187$, $p < 0{,}05$). This highlights that the benefits of digital finance are optimized when adoption is accompanied by inclusive access to formal financial systems.

DISCUSSION

The Effect of Financial Literacy on Financial Inclusion

Recent empirical studies highlight the important role of financial literacy in supporting digital-driven financial inclusion for individuals and MSMEs.[19] Research indicates that higher levels of financial literacy are often associated with improved access to and use of formal financial services—such as digital payments, e-wallets, online banking, and credit lines—which can contribute to financial security, entrepreneurial adaptability, and business continuity.[20] These findings suggest that financial knowledge and behavior may positively influence both access and usage dimensions of financial inclusion, underscoring the relevance of literacy within digitally evolving financial ecosystems.[21]

Importantly, financial literacy not only facilitates access but also improves the quality of financial decision-making in a digital economy.[22] Enhanced literacy contributes to more disciplined repayment practices, greater adoption of electronic savings mechanisms, and long-term planning capacity supported by digital tools.[23] Policymakers, therefore, must consider financial education as a strategic instrument for inclusive digital development.[24] Randomized controlled trials and econometric analyses highlight that strengthening financial literacy boosts confidence in engaging with formal financial providers, reduces barriers to adopting innovative technologies, and builds trust in digital financial platforms.[25]

The integration of e-commerce further amplifies these effects by serving as both a market expansion tool and a catalyst for digital financial inclusion.[26] By broadening MSMEs' customer bases, generating new revenue streams, and creating transactional data, e-commerce participation produces valuable digital footprints.[27] These data traces can be leveraged by financial institutions to develop more accurate credit scoring systems, thereby enabling MSMEs to access formal financing.[28] This dynamic illustrates the synergistic role of financial literacy, digital adoption, and technological innovation in driving inclusive and measurable economic outcomes.[29]

From a policy perspective, several priorities emerge. First, financial-digital literacy programs should be systematically embedded within national digital transformation agendas to empower MSMEs and communities in adopting and optimizing financial technologies.[30] Second, incentives for QR-based and contactless payments must be expanded to accelerate the transition toward cashless ecosystems. Third, improving interoperability across financial service providers is essential to minimize fragmentation, foster innovation, and enhance system efficiency.[31] Finally, the adoption of electronic invoicing and digital accounting systems provides transparent banking data trails, enabling more accurate credit risk assessments and widening access to formal financing.[32]

In sum, advancing financial literacy—integrated with digital adoption through e-commerce platforms and supported by regulatory innovations—constitutes a foundational strategy for building inclusive, sustainable, and technology-enabled financial ecosystems.[33] This approach not only enhances MSME performance but also strengthens social and economic resilience in the era of digital transformation.[34]

The Effect of Financial Technology Adoption on Financial Inclusion

Emerging scholarship increasingly demonstrates that fintech adoption acts as a catalyst for digital transformation in financial systems, with direct implications for social and economic inclusion.[35] Recent empirical evidence from India, employing PLS-SEM, reveals that the adoption of mobile wallets and online lending significantly improves access, utilization, and quality of financial services, while digital financial literacy mediates this effect.[36] This finding underlines that technology alone cannot generate inclusion; it must be accompanied by user competencies in navigating digital platforms effectively.[37]

Within the MSME ecosystem, studies in Indonesia during the COVID-19 pandemic show that digital financial products offered through fintech platforms enabled enterprises to remain connected to formal financial

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systems, thereby reinforcing financial inclusion.[38] The efficiency, user-friendliness, and time-saving attributes of fintech were particularly decisive in supporting adoption and sustaining business operations.[39] Moreover, fintech adoption not only ensured short-term resilience but also enhanced the long-term competitiveness of MSMEs by lowering transaction costs, diversifying financing opportunities, and expanding market reach.[40]

An additional layer of interpretation highlights the role of e-commerce as a complementary enabler of fintech-driven inclusion.[41] Digital marketplaces not only expand customer bases and generate higher turnover but also produce transactional data that financial institutions can leverage for credit scoring and risk assessment.[42] This creates a data-driven feedback loop in which MSMEs that actively engage in digital commerce strengthen their financial visibility, improve access to formal credit, and enhance sustainability prospects.[43] The synergistic interaction between fintech and e-commerce thus fosters both inclusion and technological upgrading.[44]

From a policy and practice standpoint, several transformative implications arise.[45] First, integrated financial and digital literacy programs are critical to building user cpacity in adopting and optimizing fintech innovations. Second, incentives for QR-based payments can accelerate the normalization of cashless transactions in everyday business practices.[46] Third, cross-platform interoperability among financial service providers will reduce fragmentation and increase systemic efficiency in the digital ecosystem.[47] Finally, the introduction of electronic invoicing systems can create verifiable banking data trails, improving creditworthiness assessments and broadening MSMEs' access to formal financing channels.[48]

In sum, fostering an inclusive and technology-enabled financial ecosystem requires more than just the provision of fintech services. It demands the integration of literacy, e-commerce mechanisms, and supportive regulatory frameworks, all of which converge to drive sustainable financial inclusion, digital innovation, and broader socio-economic transformation.[49]

The Effect of Financial Literacy on MSME Financial Performance

Financial literacy among MSME owners exerts a significant influence on firm performance, particularly when combined with digital transformation and financial innovation. Beyond enabling cash flow management, budgeting, and investment planning, financial literacy empowers entrepreneurs to strategically leverage digital platforms for sustainable growth. Evidence from recent studies shows that financially literate and technologically adaptive entrepreneurs achieve higher profitability, resilience, and competitiveness in the digital economy.[49] This underscores that financial literacy is not only a cognitive asset but also a strategic enabler of socio-economic advancement.[49]

Access to finance and risk management further mediate the literacy-performance link. In emerging markets, enhanced literacy strengthens entrepreneurs' ability to manage debt, reinvest earnings, and monitor financial health using digital tools and fintech applications.[50] Literate entrepreneurs are more likely to engage proactively with formal lenders, adopt mobile-based credit systems, and use risk-hedging instruments. These practices reduce vulnerability while promoting financial inclusion, stability, and long-term performance.[51]

Social capital also amplifies the effects of financial and digital literacy. MSMEs embedded in networks of trust and collaborative knowledge exchange benefit from collective learning, shared innovations, and broader access to markets.[51] When integrated with digital ecosystems, such as fintech and e-commerce, social capital generates a multiplier effect that fosters resilience, innovation capacity, and inclusive growth.

E-commerce platforms, in particular, reinforce the literacy–performance nexus by expanding market reach and providing MSMEs with valuable transactional data. These digital footprints facilitate credit scoring, enhance access to finance, and enable data-driven decision-making. Financially literate MSME owners are better equipped to interpret such data, negotiate with providers, and strategically employ digital solutions to scale operations.

The policy implications are clear. Integrated financial–digital literacy programs should be prioritized to ensure MSMEs not only manage finances effectively but also harness technology for innovation and inclusion. Incentives for QR code–based payments and mobile wallets can accelerate transparent, traceable transactions, while interoperability among financial systems reduces costs and improves efficiency. Moreover, implementing electronic invoicing and digital audit trails strengthens creditworthiness, enhances trust, and enables regulators to expand financial inclusion sustainably.[52]

In conclusion, financial literacy—when combined with social capital, digital technologies, and enabling policies—serves as a cornerstone of inclusive and sustainable MSME performance. It transforms literacy from a mere knowledge base into a driver of innovation, digital adoption, and socio-economic empowerment, aligning directly with the goals of technological advancement and social development.

The Effect of Financial Technology Adoption on Financial Performance

Recent studies indicate that digital financial innovation—particularly fintech adoption—plays a transformative role in strengthening MSME performance by improving revenue growth, operational efficiency, and long-term sustainability. Evidence from Indonesia demonstrates that SMEs adopting mobile banking, QR-based payments, and digital wallets during the COVID-19 pandemic maintained business continuity, enhanced liquidity, and optimized cash flow management.[53,54] These digital solutions reduce transactional frictions while providing more reliable financial records, which are critical for transparent reporting and strategic planning.

Beyond efficiency gains, fintech adoption contributes to inclusive financial ecosystems by enabling MSMEs to access new markets and formal credit channels. Empirical research shows that integration with e-commerce platforms and digital accounting systems not only reduces operational costs but also generates structured data that can be leveraged for loan applications, performance monitoring, and credit scoring.[48] This integration reduces the information asymmetry between MSMEs and financial institutions, ultimately strengthening financial inclusion and resilience.[55,56]

E-commerce further amplifies these benefits by serving as a reinforcing mechanism for fintech adoption. Digital marketplaces expand customer reach, while fintech-based payment solutions enhance trust and credibility. When combined with data-driven analytics, these platforms foster innovation and resource optimization, particularly for MSME owners with higher financial and digital literacy. Such capabilities accelerate informed decision-making, improve competitiveness, and stimulate social-economic empowerment within local communities.[57,58]

The policy implications are significant. Governments and regulators must prioritize digital and financial literacy programs, ensuring that MSME owners are equipped to adopt and maximize the potential of emerging technologies. Policy incentives for QR-based transactions, interoperability among fintech, e-commerce, and banking ecosystems, and the promotion of e-invoicing systems are crucial to improve transparency, reduce hidden costs, and enable more accurate creditworthiness assessments. These measures not only support MSME growth but also enhance economic resilience and inclusive development.

In conclusion, fintech adoption should be framed as part of a broader digital transformation strategy that integrates literacy, regulatory frameworks, and inclusive digital ecosystems. By embedding fintech tools into e-commerce platforms and linking them with enabling policies, MSMEs can achieve not only short-term operational improvements but also long-term competitiveness, innovation, and socio-economic sustainability.

The Effect of Financial Inclusion on Financial Performance

Financial inclusion has increasingly evolved beyond traditional access to credit, insurance, and savings, becoming a critical enabler of digital transformation for MSMEs. Empirical evidence demonstrates that firms with higher levels of inclusion through digital banking and fintech platforms exhibit stronger return on assets, greater revenue stability, and improved resilience to external shocks.[59] By reducing reliance on informal lenders and high-cost credit, digital-based financial inclusion strengthens financial stability and enables sustained business performance.

Moreover, inclusion enhances investment capacity and long-term growth potential. Formal access to credit and insurance fosters reinvestment, scalability, and innovation, while simultaneously building firm credibility in formal financial ecosystems.[43] MSMEs that adopt inclusive financial services are more likely to integrate structured credit instruments and digital insurance solutions, thereby improving their adaptability to unexpected disruptions and ensuring sustainable growth trajectories.[50]

A transformative mechanism reinforcing inclusion is the integration of e-commerce and fintech ecosystems. Digital marketplaces generate transparent and verifiable transactional data—such as turnover, cash flow, and customer engagement—that financial institutions can utilize to assess creditworthiness. When linked with fintech-enabled payment systems, this creates a data-driven cycle of growth: e-commerce platforms expand market access, fintech ensures seamless transactions and financial reporting, and inclusive finance converts these digital records into accessible capital for MSME development.[59]

The policy implications are significant. Strengthening financial–digital literacy is essential to ensure MSMEs can effectively leverage inclusion mechanisms. Governments should incentivize the adoption of QR-based payments and interoperable digital ecosystems that integrate banking, e-commerce, and fintech platforms. Additionally, mandating electronic invoicing (e-invoicing) enhances transparency, creates standardized financial data, and facilitates broader credit access. Targeted support for inclusive digital insurance products would further help MSMEs mitigate risks, ensuring continuity during economic or health-related shocks.

In conclusion, financial inclusion in the digital era functions as a multiplier, reinforcing financial literacy, fintech adoption, and e-commerce participation. When embedded within supportive regulatory frameworks, inclusion shifts from being a mere facilitator of access to finance toward becoming a transformative driver of innovation, resilience, and socio-economic sustainability for MSMEs.

The Effect of Financial Literacy on Financial Inclusion and MSME Financial Performance

Recent empirical work often reports positive associations between financial literacy, financial inclusion, and MSME outcomes; however, our results do not support a mediated pathway in this sample. Specifically, the indirect effect of financial literacy on MSME financial performance through financial inclusion is small and statistically non-significant (ß ≈ 0,033, $p > 0,05$), indicating insufficient evidence that inclusion transmits the effect of literacy onto performance in the current context.[59] Accordingly, H6 is not supported.

This pattern suggests that improvements in financial literacy may not automatically translate into measurable performance gains via inclusion, at least in the short run. Several contextual factors could weaken the mediation channel: limited suitability of available financial products for micro and small enterprises, frictions in digital onboarding, transaction costs, documentation requirements, risk perceptions, or uneven digital infrastructure across urban–rural areas. Measurement features may also play a role—for example, inclusion indicators that capture "access" more than "depth of use," or low variability in key indicators—thereby attenuating the indirect path.

From a policy and managerial perspective, these findings caution against relying on literacy training alone to lift MSME performance via inclusion. Interventions may need complementary levers—product-market fit (e.g., working-capital lines aligned with cash-flow cycles), usability of fintech tools, merchant acceptance networks, trust-building and consumer protection, and tailored incentives for sustained usage—before literacy gains can translate into performance improvements. Future studies could test moderated or longitudinal mediation (e.g., by firm size, sector, or digital readiness) to identify conditions under which the literacy → inclusion → performance pathway becomes operative.[60]

The Effect of Financial Technology Adoption on Financial Inclusion and MSME Financial Performance

Empirical evidence highlights that financial technology (fintech) adoption serves as a critical driver of digital transformation and financial inclusion, particularly when mediated by digital financial literacy and reinforced by enabling regulatory frameworks. A large-scale survey of Indonesian fintech users demonstrated that fintech usage directly enhances inclusion, while digital literacy amplifies this effect. Moreover, institutional trust and the perceived quality of digital services play a crucial moderating role, reinforcing the socio-economic legitimacy of fintech systems.[50] These findings suggest that fintech, when integrated with literacy and trust, substantially improves access to formal financial services.[61]

With respect to downstream performance, research on Indonesian micro, small, and medium enterprises (MSMEs) confirms that fintech adoption embedded within inclusive financial environments enhances business performance through increased inclusion. Evidece shows that inclusion mediates the relationship between fintech and financial performance: fintech adoption strengthens financial inclusion, which subsequently improves revenue stability, profitability, and investment capacity.[57] This trajectory illustrates that fintech adoption can indirectly drive financial performance by expanding access pathways and lowering barriers to participation in the digital economy.[62]

A key transformative mechanism in this relationship is the integration of fintech into e-commerce ecosystems, which accelerates innovation and creates new forms of socio-economic value. Embedded payment gateways, digital wallets, and buy-now-pay-later (BNPL) services not only expand market access for MSMEs but also generate digital transaction footprints. These data points function as proxies for creditworthiness, enabling access to microcredit, insurance, and investment products that were previously inaccessible. In this way, fintech and e-commerce jointly convert ordinary sales transactions into inclusion-enabling digital assets, fostering greater entrepreneurial resilience and long-term growth.

The policy implications are equally significant. Regulators should prioritize interoperability between fintech platforms, e-commerce providers, and traditional banking systems, ensuring that MSME transaction histories seamlessly inform credit scoring models. At the same time, data protection and consumer trust frameworks must be reinforced to legitimize fintech adoption and reduce perceptions of digital risk. Governments can also stimulate ecosystem-based innovation by incentivizing partnerships that connect fintech with e-commerce and formal financial institutions, creating an integrated pathway for inclusion. Finally, targeted MSME incentives—such as subsidized digital transaction fees, preferential tax treatment for fintech adoption, and capacity-building programs in digital financial literacy—can accelerate the diffusion of innovation and its socio-economic benefits.[62]

In conclusion, fintech adoption should be understood not as a standalone driver but as a catalyst within a broader digital transformation ecosystem. Its impact becomes most meaningful when combined with literacy, trust, regulation, and technological integration with e-commerce. Under these conditions, fintech not only advances financial inclusion but also generates measurable improvements in MSME financial performance, thereby supporting inclusive, innovative, and sustainable socio-economic development.

CONCLUSIONS

Financial literacy and financial technology (fintech) adoption are critical enablers in advancing digital transformation for Micro, Small, and Medium Enterprises (MSMEs). Their synergistic interaction demonstrates how knowledge resources and technological innovation jointly enhance financial inclusion and strengthen financial performance. Financial inclusion, therefore, operates not only as an outcome of improved literacy and technology adoption but also as a mediating mechanism that integrates these dimensions into sustainable business practices. From a broader socio-economic perspective, inclusive finance contributes to resilience, competitiveness, and long-term growth of MSMEs. Nonetheless, persistent structural and institutional constraints—such as limited access to digital infrastructure, regulatory gaps, and unequal educational attainment—highlight that the path toward inclusive digital finance remains an evolving process. This underscores the necessity for coordinated efforts across education, technology development, and regulatory innovation to ensure that digital financial transformation produces equitable and sustainable socio-economic impacts.

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CONFLICT OF INTEREST
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