

E-Commerce, Financial Technology, and MSME Development: The Moderating Role of Digital Literacy in Islamic Economics

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Abstract

Purpose: This study examines the direct effects of e-commerce, financial technology, and digital literacy on MSME development in Medan City, tests digital literacy as a moderator, and interprets the findings from an Islamic economic perspective.

Methods: A quantitative cross-sectional survey involved 85 digitally active MSME owners or operators purposively selected from a population of 38,343 businesses. Five-point Likert data were analyzed using partial least squares structural equation modeling (PLS-SEM). **Results:** E-commerce ($\beta = .256$; $p = .013$), financial technology ($\beta = .359$; $p = .001$), and digital literacy ($\beta = .359$; $p < .001$) each had positive direct effects. The model explained 73.3% of MSME-development variance. Digital literacy did not moderate the financial-technology relationship ($\beta = .005$; $p = .959$) or the e-commerce relationship ($\beta = -.057$; $p = .592$). **Implications:** Digital literacy operates primarily as a direct business capability. MSME support should combine e-commerce optimization, secure digital finance, and Sharia-compliant digital-literacy development based on transparency, mutual consent, justice, and avoidance of *riba*, *gharar*, *maysir*, *tadlis*, and prohibited transactions.

INTRODUCTION

Micro, small, and medium enterprises (MSMEs) constitute a broad-based segment of the economy because they create employment, distribute income, support household resilience, and sustain local markets. Their organizational flexibility has enabled many small businesses to continue operating during periods of disruption, yet persistent constraints in managerial capability, access to capital, technology adoption, and financial administration continue to restrict business growth (Ilmi, 2021; Kadeni & Srijani, 2020; Undari & Lubis, 2021). MSME development therefore requires more than an increase in the number of business units; it requires stronger market access, efficient transactions, reliable financial services, better business knowledge, and the capacity to transform digital tools into measurable economic value.

Digital transformation offers practical mechanisms for addressing several of these constraints. For MSMEs, digitalization can extend market reach, reduce information and transaction barriers, improve coordination, and strengthen competitiveness when technology becomes integrated into business processes rather than used only as an auxiliary tool (Putra, Solechan, & Hartono, 2023). Two technologies are particularly relevant to everyday MSME operations: e-commerce, which supports online commercial activity, and financial technology (fintech), which digitizes payments, financing, recordkeeping, and other financial services.

E-commerce enables entrepreneurs to display products, communicate with customers, conduct sales, coordinate delivery, and reach markets beyond their immediate location. Its business value is associated with wider market coverage, lower promotional barriers, faster transactions, and access to platform-based marketing features. Previous studies in Indonesia have reported positive relationships between e-commerce use and MSME income or performance, although the magnitude of the benefit differs across sectors, locations, and levels of utilization (Emilia, Ayunda,

& Achmad, 2023; Hasyim, 2022; Yusuf, 2022). The practical distinction between merely having an online account and integrating e-commerce into pricing, promotion, customer management, and distribution is therefore important.

Fintech complements e-commerce by providing digital payment and financial-service infrastructure. Digital payments can reduce cash-handling constraints, accelerate settlement, and generate traceable transaction records, while digital financial platforms may widen access to information and financing. Evidence from Indonesian MSMEs generally indicates that fintech can improve transaction efficiency and financial performance, although trust, security, platform reliability, pricing transparency, and user capability remain relevant adoption considerations (Dalimunthe, Rahma, & Syarvina, 2023; Hambali, Nendissa, Mayndarto, Djibran, & Dinsar, 2024; Hasyim, 2022). The strategic issue is consequently not only whether fintech is available, but whether it is used consistently, securely, and appropriately in routine business operations.

The thesis underlying this article identifies an adoption-utilization gap among MSMEs in Medan City. Entrepreneurs increasingly use e-commerce accounts and digital payment instruments, but adoption does not automatically produce proportional improvements in turnover, efficiency, or market expansion. Some users employ digital platforms only for basic transactions, whereas others use them as integrated business instruments. This pattern suggests that human capability may be as important as access to technology itself.

Digital literacy is relevant because it extends beyond the technical ability to operate a device. In an MSME context, it includes the ability to locate and evaluate information, create and manage digital content, use marketplace functions, protect business and customer data, understand platform risks, and continuously update technological competence (Farhan, Eryanto, & Saptono, 2022; Yulian & Mudiharso, 2026). These capabilities can contribute directly to marketing quality, customer communication, opportunity recognition, risk control, and managerial decision-making.

Digital literacy may also change the strength of the relationship between technology use and business development. An entrepreneur who understands platform functions, digital security, customer analytics, and online content may extract greater value from the same e-commerce or fintech service than a less capable user. However, contemporary platforms increasingly provide simplified interfaces, automated recommendations, tutorials, integrated logistics, and customer support. These features may reduce capability differences at the basic-use level and weaken the expected moderating effect.

Prior research leaves this issue unresolved. Candra and Pabulo (2021) reported a mediating role of digitalization knowledge in technology-performance relationships, while Daulay (2023) examined a moderating mechanism involving digital marketing. More recent work also shows that the performance effects of financial technology and e-commerce may depend on complementary business characteristics rather than on a single digital capability (Lestari & Sartika, 2025). These studies are informative, but mediation, moderation, and direct effects represent different mechanisms. It therefore remains necessary to test whether digital literacy strengthens the effects of e-commerce and fintech or instead contributes independently to MSME development.

The Islamic economic perspective adds an ethical and contractual dimension to this empirical question. Digital transactions are permissible forms of muamalah when the parties act voluntarily, the object and price are clear, contractual information is transparent, and the transaction avoids *riba*, *gharar*, *maysir*, *tadlis*, injustice, and prohibited objects. E-commerce arrangements in which payment and delivery occur at different times require clear product specifications, delivery terms, and obligations. Fintech must likewise be evaluated according to its

underlying contract and service mechanism, including national Sharia guidance on electronic money and technology-based financing (Dewan Syariah Nasional-Majelis Ulama Indonesia [DSN-MUI], 2017, 2018). Digitalization is therefore not ethically neutral; its contribution to MSME development should be accompanied by contractual clarity, data security, fairness, and accountability.

Based on these practical, empirical, and normative gaps, this study has three objectives: to determine the direct effects of e-commerce, financial technology, and digital literacy on MSME development; to test whether digital literacy moderates the effects of e-commerce and financial technology; and to formulate implications for Sharia-compliant MSME digitalization in Medan City. The novelty lies in separating the direct capability effect of digital literacy from its proposed moderating role while interpreting the resulting structural model through Islamic economic principles. Five hypotheses are tested: H1, e-commerce positively affects MSME development; H2, financial technology positively affects MSME development; H3, digital literacy positively affects MSME development; H4, digital literacy strengthens the effect of financial technology on MSME development; and H5, digital literacy strengthens the effect of e-commerce on MSME development.

METHODS

This study employed a quantitative cross-sectional causal-comparative design. The research was conducted among MSME actors in Medan City, North Sumatra, beginning on 10 August 2025. The study population comprised 38,343 MSME actors recorded by the relevant municipal authority responsible for cooperatives, MSMEs, industry, and trade. Because the research focused specifically on digital business practices, respondents were selected through non-probability purposive sampling. Eligible participants were MSME owners or operators who had used both e-commerce and financial-technology services in their business activities. The final sample consisted of 85 respondents.

Primary data were collected through direct questionnaire distribution and field observation. The questionnaire used a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Each construct was represented by ten reflective indicators. E-commerce covered ease of use, market reach, marketing effectiveness, transaction efficiency, and perceived business benefit. Financial technology covered transaction convenience, transaction security, financial management, access to financial services, and usefulness. Digital literacy covered digital skills, information evaluation, technology utilization, digital security, and competency development. MSME development covered sales and profit growth, customer and market expansion, asset and capital growth, competitiveness, and overall business improvement.

Data were analyzed using partial least squares structural equation modeling (PLS-SEM) in SmartPLS. The measurement model was evaluated through outer loadings, average variance extracted (AVE), discriminant validity, and composite reliability. Loadings above .70, AVE values above .50, and composite-reliability values above .70 were treated as acceptable (Hair, Ringle, & Sarstedt, 2017). The structural model was assessed using R-squared, adjusted R², effect size (f-squared), standardized path coefficients, and bootstrapped p-values at a 5% significance level. Interaction constructs were specified for digital literacy x e-commerce and digital literacy x financial technology.

The Islamic economic interpretation was conducted after the statistical analysis. The empirical functions and risks associated with e-commerce, fintech, and digital literacy were

compared with the principles of justice, transparency, honesty, mutual consent, lawful objects, and the prohibitions of *riba*, *gharar*, *maysir*, *tadlis*, *dharar*, and *zhulm*. This normative interpretation did not replace the statistical analysis; rather, it provided an ethical and contractual framework for translating the empirical findings into Sharia-compliant recommendations.

Table 1. Constructs and Measurement Domains

Construct	Code	Measurement domains	Number of items
E-Commerce	X1	Ease of use; market reach; marketing effectiveness; transaction efficiency and benefit	10
Financial Technology	X2	Transaction convenience; security; financial management; access to financial services; usefulness	10
Digital Literacy	Z	Digital skills; digital information; technology utilization; security; competency development	10
MSME Development	Y	Sales/profit growth; market growth; asset/capital growth; business performance and continuity	10

Source: Research instrument developed in the thesis (2026).

RESULTS AND DISCUSSION

Respondent Profile

The sample represented digitally active MSMEs across several business categories. Women accounted for 47 respondents and men for 38. The largest age group was 31-40 years, followed by respondents aged 30 years or below, 41-50 years, and 51 years or above. Most respondents held a bachelor's degree, while the remainder had completed senior high school. Trading and handicraft businesses formed the largest groups, followed by fashion, culinary, and service businesses. Percentages in Table 2 are calculated from the reported frequencies using the final sample of 85 respondents.

Table 2. Respondent Characteristics

Characteristic	Category	Frequency	Percentage
Gender	Female	47	55.3%
Gender	Male	38	44.7%
Age	<= 30 years	25	29.4%
Age	31-40 years	36	42.4%
Age	41-50 years	17	20.0%
Age	>= 51 years	7	8.2%
Education	Bachelor's degree	51	60.0%
Education	Senior high school	34	40.0%
Business type	Culinary	14	16.5%
Business type	Fashion	17	20.0%
Business type	Services	11	12.9%
Business type	Handicrafts	20	23.5%
Business type	Trading	23	27.1%

Source: Thesis respondent frequencies; percentages recalculated from n = 85 (2026).

Measurement Model

All reflective indicators met the convergent-validity criterion. E-commerce loadings ranged from .849 to .909; financial-technology loadings ranged from .783 to .884; digital-literacy loadings ranged from .742 to .837; and MSME-development loadings ranged from .781 to .874. The

interaction constructs were represented as product terms and therefore produced loadings of 1.000 in the model specification. Overall, the loading results indicate that the observed items adequately represented their intended constructs.

The AVE values ranged from .641 to .773, exceeding the minimum value of .50. Composite reliability ranged from .941 to .968, indicating strong internal consistency. Discriminant validity was also supported by the Fornell-Larcker criterion because the square root of each construct's AVE exceeded its correlation with the other constructs. These results support the adequacy of the measurement model before the structural relationships are interpreted.

Table 3. Measurement Model Summary

Construct	Loading range	AVE	Composite reliability	Assessment
E-Commerce	.849-.909	.773	.968	Valid and reliable
Financial Technology	.783-.884	.686	.950	Valid and reliable
Digital Literacy	.742-.837	.641	.941	Valid and reliable
MSME Development	.781-.874	.664	.945	Valid and reliable

Source: Processed research data (2026).

Table 4. Fornell-Larcker Discriminant Validity Matrix

Construct	E-Commerce	Financial Technology	MSME Development	Digital Literacy
E-Commerce	.879			
Financial Technology	.753	.828		
MSME Development	.770	.771	.815	
Digital Literacy	.683	.603	.755	.800

Source: Processed research data (2026). Diagonal values are the square roots of AVE.

Structural Model and Hypothesis Testing

The R^2 value for MSME development was .733 and the adjusted R^2 was .714. Thus, e-commerce, financial technology, digital literacy, and the interaction terms jointly explained 73.3% of the variance in MSME development, while 26.7% was associated with factors outside the model. Using the criteria applied in the thesis, the explanatory power was substantial. The effect-size results further indicated a large effect for e-commerce ($f^2 = .471$) and moderate effects for financial technology ($f^2 = .219$) and digital literacy ($f^2 = .201$).

Table 5. Structural-Model Explanatory Power and Effect Size

Indicator / predictor	Value	Criterion	Interpretation
R^2 : MSME development	.733	Substantial	Model explains 73.3% of the variance
Adjusted R^2	.714	Substantial	Strong adjusted explanatory power
f^2 : E-Commerce	.471	Large	Largest substantive contribution
f^2 : Financial Technology	.219	Moderate	Meaningful direct contribution
f^2 : Digital Literacy	.201	Moderate	Meaningful direct contribution

Source: Processed research data (2026).

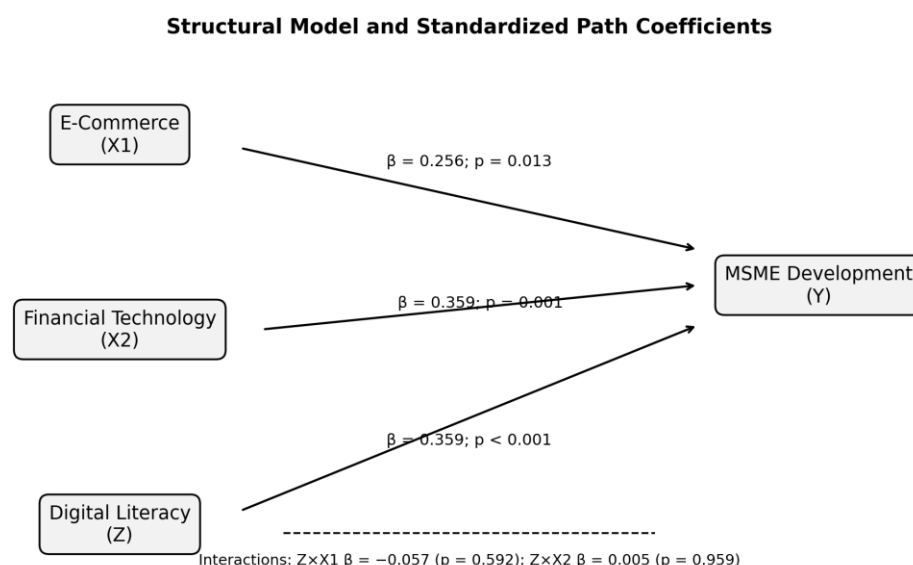


Figure 1. Structural Model and Standardized Path Coefficients

Source: Processed research data (2026).

Table 6. Hypothesis-Test Results

Hypothesis	Relationship	Path coefficient	p-value	Decision	Interpretation
H1	E-Commerce -> MSME Development	.256	.013	Supported	Positive and significant
H2	Financial Technology -> MSME Development	.359	.001	Supported	Positive and significant
H3	Digital Literacy -> MSME Development	.359	< .001	Supported	Positive and significant
H4	Digital Literacy x Financial Technology -> MSME Development	.005	.959	Not supported	No moderating effect
H5	Digital Literacy x E-Commerce -> MSME Development	-.057	.592	Not supported	No moderating effect

Source: Processed research data (2026).

Effect of E-Commerce on MSME Development

E-commerce had a positive and significant effect on MSME development ($\beta = .256$; $p = .013$). This result indicates that stronger use of digital commerce platforms is associated with higher sales potential, broader market coverage, faster transactions, and improved business competitiveness. Although the standardized coefficient was lower than those of fintech and digital literacy, e-commerce produced the largest f^2 value. This combination indicates substantial unique explanatory value within the structural model even though its standardized path coefficient was not the largest.

The finding supports previous studies reporting that online marketplaces and digital marketing can expand consumer access and improve MSME income or performance (Emilia et al., 2023; Hasyim, 2022; Yusuf, 2022). For MSMEs in Medan, the relevant mechanism extends beyond online sales. E-commerce also supports product visibility, promotional efficiency, customer communication, and market entry beyond the immediate geographic area. Consequently, MSME assistance should move beyond account registration toward product photography, searchable product descriptions, customer-response management, platform analytics, logistics coordination, and campaign evaluation.

Effect of Financial Technology on MSME Development

Financial technology had a positive and significant effect on MSME development ($\beta = .359$; $p = .001$), with a moderate effect size. Digital payments and related financial services can accelerate transactions, reduce dependence on cash, produce more organized transaction records, and widen access to financial information or financing. These functions can strengthen operational efficiency and allow small businesses to serve customers who increasingly prefer non-cash payment methods.

The result is consistent with evidence that fintech and digital payments contribute to MSME financial performance and business development (Dalimunthe et al., 2023; Hambali et al., 2024; Hasyim, 2022). However, access should be accompanied by security awareness, transparent costs, responsible borrowing, and clearer separation between personal and business finances. Fintech adoption that raises transaction volume but exposes a business to opaque fees, data misuse, or unsuitable debt cannot be treated as sustainable business development.

Direct Effect of Digital Literacy

Digital literacy positively and significantly affected MSME development ($\beta = .359$; $p < .001$), with a moderate effect size. The result confirms that the capability to use applications, evaluate online information, create digital content, protect data, and learn new technologies contributes to business development independently of the specific platform being used. Digital literacy can strengthen opportunity recognition, marketing quality, customer communication, risk awareness, and the ability to combine information from multiple digital sources.

This finding is consistent with Farhan et al. (2022) and Yulian and Mudiharso (2026), who emphasize the role of digital literacy in MSME performance, sales, competitiveness, and sustainability. From a capability perspective, technology is a resource, while literacy determines how entrepreneurs interpret information and organize digital activities. The significant direct path therefore supports continuous capability development even though the interaction hypotheses were not supported.

Why Digital Literacy Did Not Moderate the Technology Effects

The interaction between digital literacy and financial technology was not significant ($\beta = .005$; $p = .959$). The coefficient was nearly zero, indicating that the relationship between fintech use and MSME development did not materially change across literacy levels in this sample. A plausible interpretation is that commonly used payment and financial applications have become sufficiently standardized and user-friendly to provide basic operational benefits without advanced digital competence. Transaction demand, platform availability, perceived usefulness, trust, and infrastructure may therefore be more decisive boundary conditions than literacy for the fintech-development relationship.

The interaction between digital literacy and e-commerce was also not significant ($\beta = -.057$; $p = .592$). The small negative coefficient should not be interpreted as evidence that literacy is harmful; because the interaction is statistically non-significant, its direction is inconclusive. Marketplaces increasingly provide templates, automated recommendations, tutorials, customer-service support, integrated logistics, and simplified seller interfaces. These facilities can reduce skill differences at the basic-use level. Product quality, price, consumer demand, service responsiveness, promotional spending, and platform algorithms may also shape sales outcomes more strongly than the interaction between platform use and general digital literacy.

The rejected moderation hypotheses differ from studies in which digital knowledge mediated or otherwise conditioned technology-performance relationships, including Candra and Pabulo (2021) and Daulay (2023). The difference may be associated with research location, sample composition, technology maturity, construct specification, or the methodological distinction between mediation and moderation. In the present model, digital literacy is better classified as a direct predictor than as a moderator. This distinction is theoretically meaningful because entrepreneurs can benefit from literacy through improved information processing and management practices even when literacy does not change the marginal effect of a particular platform.

Islamic Economic Interpretation

The positive direct effects indicate that digital commerce and digital financial services can support productivity, market access, and business continuity. These outcomes are consistent with the Islamic objective of generating lawful benefit and protecting property, provided that the means of achieving them also comply with Sharia principles. In e-commerce, compliance requires truthful product representation, lawful objects, clear prices and quantities, identifiable parties, transparent delivery and return conditions, and genuine consent. Deceptive photographs, hidden defects, fabricated reviews, uncertain delivery, or manipulation of buyers create ethical and contractual risks associated with *tadlis* and *gharar*.

Financial technology should be assessed according to its underlying contract rather than the technology itself. Electronic payments and financing services may use appropriate Sharia-compatible contractual structures, but DSN-MUI guidance requires the avoidance of *riba*, *gharar*, *maysir*, *tadlis*, *dharar*, *zhulm*, unlawful objects, and other prohibited practices (DSN-MUI, 2017, 2018). MSMEs should therefore distinguish between efficient digital finance and products whose pricing, penalties, or contractual uncertainty create unjustified additions or unfair risk allocation.

Digital literacy also has a Sharia-relevant protective function. Better literacy can support verification of information, protection of customer data, understanding of contractual terms, responsible financial decisions, and avoidance of fraudulent schemes. Its direct positive effect in the model suggests that training should combine technical competencies with digital ethics and *muamalah* literacy. The objective is not simply to increase platform use, but to develop transparent, trustworthy, secure, and productive digital businesses.

Table 7. Sharia-Compliant Digitalization Framework for MSMEs

Area	Required practice	Prohibited / high-risk practice	Expected MSME benefit
E-Commerce	Clear product, price, delivery, and return terms; mutual consent	Deception, hidden defects, excessive uncertainty, unlawful products	Wider lawful market access and customer trust
Digital payments	Transparent fees, secure authorization, traceable settlement	Opaque charges, data misuse, unauthorized transactions	Faster and safer transactions
Digital financing	Appropriate Sharia contract, fair risk allocation, clear obligations	Interest-based additions, unjust penalties, <i>gharar</i> , <i>maysir</i> , <i>zhulm</i>	Responsible access to productive finance
Digital literacy	Verification, data protection, contract understanding, ethical content	Fraudulent content, privacy violations, irresponsible borrowing	Capability, resilience, informed decisions

Source: Synthesized from the empirical findings and DSN-MUI Fatwas No. 116/2017 and No. 117/2018.

Theoretical and Practical Implications

Theoretically, the findings distinguish technological resources from digital capability. E-commerce and financial technology each contribute directly to MSME development, while digital literacy contributes through an independent pathway. The absence of moderation cautions against automatically assigning digital literacy a boundary-condition role. Depending on platform maturity

and user context, literacy may operate as a parallel entrepreneurial capability rather than a mechanism that magnifies every technology effect.

Practically, MSME development programs should be organized into three coordinated tracks. The first is platform utilization, including stronger online storefronts, content quality, consumer response, logistics, and analytics. The second is financial digitalization, including secure non-cash payment, reliable transaction records, and suitable financing with effective control of costs and risks. The third is capability development, including information evaluation, cybersecurity, digital marketing, and understanding of Sharia contracts. Because all three direct paths are significant, these tracks should complement rather than substitute for one another.

For government agencies and supporting institutions, program evaluation should measure utilization outcomes rather than registration alone. Relevant indicators include the proportion of sales generated online, repeat customers, transaction-processing time, completeness of digital records, cybersecurity incidents, financing quality, and compliance with transparent contractual practices. Platform providers should continue simplifying interfaces while strengthening seller education, data protection, dispute resolution, and fee disclosure.

CONCLUSION

This study concludes that e-commerce, financial technology, and digital literacy each have a positive and significant direct effect on MSME development in Medan City. E-commerce contributes through market expansion, promotion, transaction efficiency, and competitive reach; financial technology contributes through payment convenience, access to financial services, and operational efficiency; and digital literacy contributes as an independent entrepreneurial capability. Together with the interaction terms, the model explains 73.3% of the variance in MSME development.

Digital literacy does not moderate the effect of financial technology or e-commerce. In this research context, it should therefore be interpreted primarily as a direct predictor rather than as a condition that automatically strengthens platform benefits. The result suggests that user-friendly platforms and other factors, including product quality, market demand, trust, infrastructure, platform features, and managerial capability, may reduce or replace the expected interaction effect.

MSME actors are advised to deepen e-commerce use beyond account ownership, adopt secure and transparent financial technology, and strengthen digital capability through continuous learning. Government agencies, universities, financial institutions, and platform providers should integrate technical training with business mentoring, cybersecurity, financial management, and Sharia-compliance education. Digital transactions should maintain justice, transparency, honesty, mutual consent, lawful objects, data protection, and freedom from *riba*, *gharar*, *maysir*, *tadlis*, *dharar*, and *zhulm*.

The study is limited by its cross-sectional design, purposive sample of 85 digitally active MSMEs, reliance on self-reported questionnaire responses, and focus on a single city. The model also excludes other potentially relevant determinants, such as innovation, entrepreneurial orientation, digital trust, government support, technology readiness, managerial quality, and access to capital. Future research should employ larger multi-region samples, longitudinal or mixed-method designs, and alternative mediators or moderators to explain more precisely when and how digital technology produces sustained MSME development.

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