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Fintech Optimization and Digital Financial Literacy in UMKM Empowerment: A Community Service Study for Financial Inclusion in the Society 5.0 Era.

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ABSTRACT

Micro, Small, and Medium Enterprises (UMKM) play a crucial role in Indonesia's economy, contributing 61.9% to GDP and 97% to national employment. However, their digital transformation is hindered by low fintech adoption and limited digital financial literacy. This study evaluates a community service program aimed at enhancing fintech utilization and digital financial literacy among UMKM in five regencies of East Java. Using a quasi-experimental pretest-posttest control group design, 240 participants were randomly assigned to intervention and control groups. Data were collected through validated questionnaires measuring fintech adoption index (FAI), digital financial literacy index (DFLI), and business performance. The results show significant improvements in fintech adoption (21.4%, $p < 0.001$), digital financial literacy (18.7%, $p < 0.001$), and monthly revenue (17.3%, $p < 0.01$). These findings indicate that structured training integrating fintech and digital literacy effectively supports UMKM digital transformation and advances financial inclusion in the Society 5.0 era.

Keywords: digital financial literacy, fintech optimization, Society 5.00.

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INTRODUCTION

Micro, Small, and Medium Enterprises (UMKM) represent the fundamental pillars of Indonesia's economic architecture, embodying both the resilience and vulnerability of the nation's productive sector. As of 2025, Indonesia's UMKM population reached approximately 65.5 million units, contributing 61.9% to the national Gross Domestic Product (GDP) and absorbing over 119 million workers, which constitutes approximately 97% of the total national workforce. These figures are not merely

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statistical artifacts; they reflect a deeply embedded economic structure in which grassroots productive activities form the primary engine of national economic growth. The sheer magnitude of UMKM's contribution underscores its irreplaceable role in fostering employment creation, income distribution, and regional economic development across Indonesia's vast archipelago.

Nevertheless, beneath these impressive aggregate figures lie persistent and multifaceted challenges that constrain UMKM from realizing their full growth potential. Despite their dominant numerical presence, UMKMs contribution to national exports remains disproportionately low at merely 15.7% of the total export value, signaling significant gaps in competitiveness, product quality standardization, and international market penetration. More critically, the digital transformation of UMKM—a prerequisite for survival and growth in the contemporary digital economy—proceeds at an uneven and often insufficient pace. The penetration of digital financial services among UMKM stands at only 32%, with cash transactions remaining the predominant payment method for the majority of micro and small enterprises. This digital lag is compounded by pronounced regional disparities, wherein UMKM in Java and major urban centers demonstrate substantially higher technology adoption rates than their counterparts in eastern Indonesia and remote rural areas (Idrus & Rastina, 2025).

The Society 5.0 paradigm, which envisions a human-centered society that harmonizes economic advancement with the resolution of social challenges through the sophisticated integration of cyberspace and physical space, imposes new and exacting demands on UMKM actors. In the Indonesian context, Society 5.0 is not an abstract futuristic concept but an increasingly tangible policy direction that emphasizes digital connectivity, data-driven decision-making, and the deployment of advanced technologies—including artificial intelligence, the Internet of Things, and big data analytics—to enhance productivity and societal welfare. For UMKM, Society 5.0 presents both unprecedented opportunities and existential threats: those capable of adapting to digital ecosystems and leveraging financial technology will thrive, while those unable to cross the digital chasm risk obsolescence and marginalization.

Financial technology (fintech) has emerged as a potentially transformative force in bridging the UMKM financing gap and accelerating digital inclusion in Indonesia. The rapid proliferation of fintech services in Indonesia—encompassing peer-to-peer lending platforms, digital payments via QRIS, e-wallets, and digital accounting applications—offers UMKM novel pathways to access formal financial services, streamline their business operations, and expand their market reach. Empirical evidence indicates that fintech lending has contributed to increased business income for over 50% of borrower respondents, particularly those who utilize such facilities for productive purposes. The Quick Response Code Indonesian Standard (QRIS), a national standardized QR code payment system, has achieved remarkable adoption rates, with 38.1 million UMKM merchants utilizing the platform as of the first quarter of 2025, representing 93.16% of all QRIS merchants. By the first semester of 2025, QRIS had facilitated 6.05 billion transactions valued at approximately Rp579 trillion, underscoring its role as a primary conduit for digital payment adoption among small businesses (Khadir et al., 2025).

Notwithstanding the expanding fintech infrastructure, the availability of digital financial services does not automatically translate into effective and beneficial

utilization. A critical mediating factor is digital financial literacy which isdefined as the combination of awareness, knowledge, skills, attitudes, and behaviors necessary for individuals to make sound financial decisions and achieve individual financial well-being within the digital ecosystem. The National Survey on Financial Literacy and Inclusion (SNLIK) 2025 reveals that while Indonesia's overall financial literacy index has improved to 66.46% (sustainability method) and the financial inclusion index to 80.51%, significant sectoral disparities persist. Literacy rates for specific financial sectors remain alarmingly low: financing institutions at 46.66%, microfinance institutions at a mere 9.80%, and Fintech lending at only 24.90%. These figures expose a fundamental disconnect: a substantial proportion of UMKM actors lack the requisite knowledge to navigate fintech platforms safely, evaluate financial product suitability, manage digital financial risks and optimize fintech tools for business growth.

The consequences of inadequate digital financial literacy extend beyond suboptimal Fintech utilization. Research indicates that while fintech adoption positively influences financial inclusion, its direct impact on UMKM business performance is mediated by innovation capabilit and financial literacy competenc. In other words, fintech serves as an enabling infrastructure, but its transformative potential is actualized only when users possess the cognitive and behavioral competencies to strategically integrate digital financial tools within their business operations. Furthermore, low digital financial literacy heightens UMKM vulnerability to online fraud, predatory lending practices, and data security breaches—risks that are magnified in the Society 5.0 era characterized by hyperconnectivity and algorithmic decision-making (Loskorikh et al., 2026).

The tripartite mission of Indonesian higher education institutions—teaching, research, and community service (pengabdian kepada masyarakat)—positions universities as strategic agents in addressing the digital financial literacy gap among UMKM. Community service programs provide a structured and contextually grounded mechanism for translating academic knowledge and technological innovations into practical interventions that directly benefit grassroots economic actors. The regulatory framework established by the Ministry of Education, Culture, Research, and Technology mandates that community service activities address real societal problems using participatory, sustainable, and evidence-based approaches.

Recent community service initiatives across Indonesia have demonstrated promising outcomes in enhancing the digital financial capabilities of UMKM. For instance, a program conducted by Universitas Brawijaya successfully facilitated the activation of QRIS and digital banking features for a micro-enterprise in Batu City, enabling a transition from cash-dependent operations to a structured digital payment system. Similarly, Universitas Merdeka Malang implemented a coastal community empowerment program that integrated fintech training with product innovation and digital marketing, resulting in enhanced business capacity among fishing community MSMEs. The Financial Services Authority (OJK), through its GENCARKAN program, reached 70,510 UMKM participants across 180 districts and cities in 2025 alone, underscoring the scale and urgency of national efforts to enhance financial literacy among small business actors.

Despite the proliferation of community service programs targeting UMKM digital financial empowerment, several critical research gaps remain. First, most existing

studies adopt qualitative or descriptive approaches, lacking rigorous quantitative evaluation of intervention effectiveness. Second, there is an absence of standardized measurement instruments for assessing digital financial literacy and fintech optimization specifically calibrated for the Indonesian UMKM context. Third, the mechanisms through which community service interventions translate into tangible improvements in business performance remain under theorized and empirically under examined. Fourth, the differential effects of various intervention modalities such as hands-on training versus digital self-learning modules have not been systematically compared (Salim et al., 2026).

Against this backdrop, the present study addresses the following research questions:

To what extent does a structured community service intervention program improve fintech adoption and digital financial literacy among UMKM participants?

What is the relationship between enhanced digital financial literacy, fintech optimization, and business performance metrics among UMKM?

How do the outcomes of direct training interventions compare with self-guided digital learning approaches in promoting UMKM digital financial capabilit?

What are the implications of community service-driven fintech optimization for advancing national financial inclusion targets in Society 5.0?

The primary objectives of this study weare threefold. First, it seeks to design, implement, and rigorously evaluate a community service intervention program aimed at optimizing fintech utilization and enhancing digital financial literacy among UMKM actors in East Java. Second, thise study aims to develop and validate measurement instruments for assessing digital financial literacy and fintech optimization in the Indonesian UMKM context. Third, thise study endeavors to generate evidence-based policy recommendations for scaling community service programs as a strategic instrument for achieving national financial inclusion targets.

The significance of this study is both academic and practical in nature. Academically, it contributes to the growing body of literature on digital financial inclusion by providing robust quantitative evidence of the efficacy of community service interventions. It also advances the conceptualization and measurement of digital financial literacy as a multidimensional construct that encompasses knowledge, skills, behavioral intentions, and risk management capabilities. Practically, the findings offer actionable insights for policymakers at the OJK, Bank Indonesia, and the Ministry of Cooperatives and SMEs in designing and evaluating national financial literacy programs. For higher education institutions, thise study provides a replicable model for community service activities that demonstrably enhance UMKM capacity in the digital economy.

METHOD

This study employed a quantitative research methodology utilizing a quasi-experimental pretest-posttest control group design. This design was selected to enable arigorous evaluation of the intervention effects while accommodating the practical constraints inherent in community-based research with UMKM participants. The quasi-experimental design allows for causal inference regarding the relationship between

community service intervention and observed outcomes, while the inclusion of a control group mitigates threats to internal validity arising from maturation, history, and testing effects (Creswell, 2021).

The research design comprised three phases: a pretest phase (T1) during which baseline measurements of fintech adoption, digital financial literacy, and business performance were collected from both the intervention and control groups; an intervention phase during which the intervention group received the structured community service program while the control group received self-guided digital learning materials; and a posttest phase (T2) conducted four weeks after intervention completion, during which outcome measurements were repeated. This temporal separation between intervention delivery and post test measurement reduced the risk of short-term recall effects artificially inflating observed improvements.

The target population for this study comprised UMKM actors in East Java Province, Indonesia. East Java was selected as the research locus based on several considerations: it represents Indonesia's second most populous province with a substantial UMKM concentration; it encompasses diverse economic sectors including manufacturing, trade, agriculture, and services; and it exhibits variation in digital infrastructure access and financial inclusion levels across its regencies and municipalities (Sugiyono, 2019).

Sample size determination followed the guidelines established by Cohen (1992) for detecting medium effect sizes ($f^2 = 0.15$) with a statistical power of 0.80 at $\alpha = 0.05$ in multiple regression analysis. Based on these parameters, a minimum sample size of 107 participants per group was necessary. Considering an anticipated attrition rate of 15% in community-based research, a target sample of 126 participants per group was established. The final sample comprised 240 UMKM actors randomly assigned to the intervention (n = 120) and control (n = 120) groups, exceeding the minimum sample size requirements.

Participants were recruited through collaboration with local cooperative and SME agencies (Dinas Koperasi dan UKM) across five regencies in East Java: Malang, Pasuruan, Mojokerto, Jombang, and Lamongan. The inclusion criteria stipulated that participants must: (1) be owners or principal managers of registered UMKM; (2) have been in business operation for a minimum of one year; (3) possess a smartphone capable of running fintech applications; and (4) express willingness to participate in the full duration of the research. Random assignment to the intervention and control groups was conducted using computer-generated random numbers stratified by regency and business sector to ensure group equivalence on key demographic and business characteristics.

The community service intervention program, titled the "UMKM Digital Finance Acceleration Program," was designed as a multi-component, participatory intervention delivered over a four-week period. The program curriculum was developed based on a systematic needs assessment involving focus group discussions with 30 UMKM representatives and consultations with financial service providers and local government agencies.

The intervention comprised four core modules delivered through weekly three hour sessions. Module 1: Digital Financial Ecosystem Orientation introduced participants to the Indonesian fintech landscape, covering digital payment systems (QRIS and e-wallets), digital banking services, peer-to-peer lending platforms, and digital financial

management applications. The module emphasizes consumer protection mechanisms and risk awareness, including the identification of fraudulent schemes and predatory lending practices. Module 2: Hands-On QRIS and E-Wallet Activation provided guided, individualized assistance in registering QRIS merchant accounts and activating digital wallets. The facilitators supported the participants through each step of the registration, verification, and activation process, ensuring functional installation and initial transaction execution. Module 3: Digital Financial Record-Keeping introduced participants to digital accounting applications suitable for micro and small enterprises, including features for income and expense tracking, inventory management, and basic financial reporting. The participants received guided practice in entering transaction data, generating financial summaries, and interpreting basic financial indicators. Module 4: Accessing Digital Financing and Business Growth Planning covered the landscape of digital financing options available to UMKM, including KUR digital, peer-to-peer lending platforms, and microfinance applications. The module addressed credit assessment criteria, responsible borrowing practices, and strategies for building digital credit profiles through the consistent use of digital payment and record-keeping systems.

The intervention employed diverse pedagogical approaches to accommodate various learning styles and technological proficiency levels. Each session incorporated short didactic presentations (20-30 minutes), hands-on practice sessions with facilitator guidance (60-90 minutes), peer-to-peer learning and experience sharing (30-45 minutes), and individual consultations (15-30 minutes per participant). Facilitators were recruited from among final-year students and recent graduates of economics and information technology programs at participating universities, who underwent 20 hours of standardized training prior to program delivery.

Participants in the control group received access to a curated collection of self-guided digital learning materials, including instructional videos, e-booklets, and website resources covering the same content domains as the intervention. Control group participants received these materials via WhatsApp and were instructed to review them independently at their own pace, without facilitator guidance or peer interaction.

Thise study examined three categories of variables. The independent variables included group assignment (intervention vs. control) and participant demographicw and business characteristics (age, gender, educational attainment, business sector, business size, years in operation, and baseline digital proficiency). The dependent variables comprised fintech adoption, digital financial literacy, and business performance metrics. Digital financial literacy was included as a hypothesized mediator and participant characteristics were included as moderators.

Measurement instruments were developed through a rigorous process incorporating a literature review, expert validation, and pilot testing. The Fintech Adoption Index (FAI) was measured using a 15-item scale adapted from the technology acceptance literature and validated in the Indonesian UMKM context. The scale assessed adoption across four dimensions: digital payment usage (five items, e.g., "I use QRIS to receive payments from customers"), digital banking utilization (3 items, e.g., "I use mobile banking applications for business transactions"), digital financing engagement (4 items, e.g., "I have applied for or received financing through digital lending platforms"), and digital financial management application usage (3 items, e.g., "I use

digital applications to record business income and expenses"). Items were rated on a 5-point Likert scale ranging from 1 ("never") to 5 ("always"). The FAI demonstrated strong internal consistency during pilot testing (Cronbach's $\alpha = 0.86$).

The (DFLI) was measured using a 20-item instrument developed specifically for this study, incorporating dimensions identified in the OECD/INFE financial literacy framework and adapted for the digital financial context. The DFLI assesses four dimensions: knowledge (six items, multiple-choice questions assessing understanding of digital financial products, terminology, and consumer protection), skills (five items, self-reported confidence in performing specific digital financial tasks rated on a 5-point scale), attitudes (five items, Likert-scale items assessing trust, perceived risk, and perceived benefit of digital financial services), and behaviors (four items, frequency and diversity of digital financial service usage). The DFLI demonstrated acceptable internal consistency (Cronbach's $\alpha = 0.82$) and test-retest reliability ($r = 0.84$, $p < 0.001$) during pilot testing.

Business Performance Metrics included monthly revenue (self-reported in Indonesian Rupiah, verified against available financial records where possible) and operational efficiency (composite score derived from four items assessing time spent on financial administration, transaction processing speed, record-keeping accuracy, and customer payment convenience, rated on a 5-point Likert scale). The operational efficiency scale demonstrated internal consistency with a Cronbach's α of 0.78.

Data collection was conducted in three phases. Pretest Phase (T1): During the two weeks preceding the intervention, participants in both groups completed the FAI, DFLI, and business performance questionnaires. Data collection was conducted through a combination of face-to-face interviews for participants with limited literacy and self-administered digital questionnaires via Google Forms for participants who were comfortable with digital interfaces. Intervention Phase: The intervention group participated in the four-week structured program described in Section 3.3, while the control group received self-guided digital learning materials. Posttest Phase (T2): Four weeks after the intervention, participants in both groups completed identical FAI, DFLI, and business performance measures. Data collection at T2 employed the same methods as T1 to ensure consistency.

The data analysis proceeded through several sequential stages. Preliminary analyses included descriptive statistics to characterize the sample and variables, checks for data normality and outliers, and tests of group equivalence at baseline using independent samples t-tests for continuous variables and chi-square tests for categorical variables. Primary analyses employed paired sample t-tests to examine within-group changes from T1 to T2 for both the intervention and control groups independent sample t-tests to compare between-group differences in change scores and analysis of covariance (ANCOVA) to examine group effects on T2 outcomes while controlling for T1 baseline scores, thereby increasing statistical power and precision. Mediation analysis utilized the PROCESS macro for SPSS (Model 4) to test whether improvement in digital financial literacy (M) mediated the relationship between intervention participation (X) and fintech adoption (Y), with bootstrapping (5,000 samples) to generate bias-corrected confidence intervals for the indirect effects. Moderation analysis examined the interaction effects between group assignment and participant characteristics using hierarchical multiple regression. All statistical analyses were

conducted using SPSS version 27, with a significance threshold set at $\alpha = 0.05$ (two-tailed). Effect sizes were calculated using Cohen's d for mean differences and partial eta-squared (ηp) for ANCOVA.

This study was approved the Institutional Review Board of [University Name Redacted for Review] (Approval Number: IRB-2025-042). All participants provided written informed consent prior to enrollment after a detailed explanation of the study s purposes, procedures, potential risks and benefits, and the voluntary nature of participation. Participants were assured of confidentiality and anonymity in all data report and publications. No financial incentives were provided for participation; however, all participants retained access to the learning materials and received certificates of participation upon study completion. Control group participants were offered enrollment in a subsequent round of the structured intervention program after the completion of the research.

RESULTS AND DISCUSSION

The final analytical sample comprised 240 UMKM actors, with 120 participants in the intervention group and 120 in the control group. Attrition from the original enrolled sample was minimal (4 participants, 1.7%), with final retention rates of 98.3% in both groups. Table 1 presents the participants' demographic and business characteristics by group.

Table 1: Demographic and Business Characteristics of Participants.

Characteristic	Intervention (n=118)	Control (n=118)	Total (N=236)	χ^2/t	p-value
Age (years), M (SD)	38.4 (9.2)	37.9 (8.7)	38.2 (8.9)	0.43	0.668
Gender, n (%)				0.17	0.680
- Female	74 (62.7%)	71 (60.2%)	145 (61.4%)		
- Male	44 (37.3%)	47 (39.8%)	91 (38.6%)		
Education, n (%)				0.89	0.828
- Elementary	12 (10.2%)	10 (8.5%)	22 (9.3%)		
- Junior High	28 (23.7%)	31 (26.3%)	59 (25.0%)		

Characteristic	Intervention (n=118)	Control (n=118)	Total (N=236)	χ^2/t	p-value
- Senior High	54 (45.8%)	51 (43.2%)	105 (44.5%)		
- Tertiary	24 (20.3%)	26 (22.0%)	50 (21.2%)		
Business Sector, n (%)				1.21	0.750
- Food & Beverage	42 (35.6%)	39 (33.1%)	81 (34.3%)		
- Fashion & Craft	28 (23.7%)	31 (26.3%)	59 (25.0%)		
- Retail Trade	31 (26.3%)	29 (24.6%)	60 (25.4%)		
- Services	17 (14.4%)	19 (16.1%)	36 (15.3%)		
Business Size, n (%)				0.16	0.923
- Micro (<Rp300M annual)	82 (69.5%)	80 (67.8%)	162 (68.6%)		
- Small (Rp300M-2.5B)	36 (30.5%)	38 (32.2%)	74 (31.4%)		
Years in Operation, M (SD)	6.2 (4.8)	5.9 (4.5)	6.1 (4.6)	0.50	0.618
Baseline Smartphone Proficiency, n (%)				0.38	0.827

Characteristic	Intervention (n=118)	Control (n=118)	Total (N=236)	χ^2/t	p-value
- Basic	38 (32.2%)	35 (29.7%)	73 (30.9%)		
- Intermediate	56 (47.5%)	59 (50.0%)	115 (48.7%)		
- Advanced	24 (20.3%)	24 (20.3%)	48 (20.3%)		

Note: M = Mean, SD = Standard Deviation. Statistical comparisons: independent samples t-test for continuous variables and chi-square test for categorical variables.

As shown in Table 1, the intervention and control groups were statistically equivalent in terms of all demographic and business characteristics at baseline. The sample was predominantly female (61.4%), reflecting the documented gender composition of micro and small enterprisese in Indonesia. Educational attainment was concentrated at the senior high school level (44.5%), with approximately one-fifth (21.2%) of the participants having completed tertiary education. The food and beverage sector constituted the largest business category (34.3%), followed by retail trade (25.4%) and fashion and crafts (25.0%). The substantial majority of participants (68.6%) operated micro-enterprises with annual revenues below Rp300 million. The mean years in business operation was 6.1 years (SD = 4.6), indicating a sample of established rather than nascent enterprises. Baseline smartphone proficiency was distributed across basic (30.9%), intermediate (48.7%), and advanced (20.3%) levels, with no significant between-group differences in proficiency.

Table 2 presents the baseline (T1) descriptive statistics for primary outcome variables. As expected under random assignment, the intervention and control groups did not differ significantly on any baseline measure.

Table 2: Baseline (T1) Descriptive Statistics for Primary Outcome Variables

Variable	Intervention (n=118) M (SD)	Control (n=118) M (SD)	t	p-value	Cohen's d
Fintech Adoption Index (FAI)	41.2 (8.7)	40.8 (8.4)	0.36	0.720	0.05

Variable	Intervention (n=118) M (SD)	Control (n=118) M (SD)	t	p-value	Cohen's d
Digital Financial Literacy Index (DFLI)	52.6 (10.3)	51.9 (9.8)	0.54	0.590	0.07
Monthly Revenue (IDR million)	8.4 (5.2)	8.1 (4.9)	0.46	0.646	0.06
Operational Efficiency Score	2.8 (0.9)	2.9 (0.8)	-0.91	0.364	-0.12

Note: FAI range = 15-75; DFLI range = 20-100; Operational Efficiency range = 1-5.

Baseline data revealed several noteworthy patterns. Fintech adoption scores averaged approximately 41 out of a possible 75, suggesting moderate but far from optimal utilization of available digital financial tools. The average digital financial literacy scores was approximately 52 out of 100, indicating substantial room for improvement in the participants' knowledge, skills, attitudes, and behaviors regarding digital financial services. The mean monthly revenue of approximately Rp8.2 million aligns with the national statistics for micro-enterprise income levels. Operational efficiency scores below the scale midpoint (3.0) suggest that participants perceived their current financial administrative processes as relatively inefficient, consistent with the predominance of manual, cash-based financial management practices documented in the literature.

Hypothesis 1 predicted that participation in the structured community service intervention would significantly improve fintech adoption among UMKM actors compared with the control group. Table 3 presents the pre-post comparisons of the FAI scores.

Table 3: Pre-Post Comparisons of Fintech Adoption Index (FAI) Scores

Group	T1 M (SD)	T2 M (SD)	Mean Change	Paired t	p-value	Cohen's d
Intervention (n=118)	41.2 (8.7)	53.6 (9.4)	+12.4	14.82	<0.001	1.36
Control (n=118)	40.8 (8.4)	42.4 (8.9)	+1.6	2.15	0.034	0.20

The intervention group demonstrated a substantial and statistically significant increase in fintech adoption from T1 to T2, with mean FAI scores rising from 41.2 to 53.6—an improvement of 12.4 points or approximately 30.1% relative to the baseline. The effect size (Cohen's d = 1.36) substantially exceeded the conventional threshold for large effects (d = 0.80). The control group also exhibited a modest but statistically significant improvement (mean increase = 1.6 points, p = 0.034), albeit with a negligible effect size (d = 0.20), likely attributable to engagement with self-guided learning materials or general maturation effects.

To formally test the between-group differences in change scores while controlling for baseline values, an ANCOVA was conducted with T2 FAI as the dependent variable, group assignment as the fixed factor, and T1 FAI as the covariate. ANCOVA revealed a significant main effect of group assignment on T2 FAI scores after controlling for baseline differences, $F(1, 233) = 142.67$, $p < 0.001$, partial $\eta^2 = 0.38$, representing a large effect. The adjusted mean T2 FAI score for the intervention group (53.4) significantly exceeded that of the control group (42.6), with a mean difference of 10.8 points (95% CI: 9.012.6). These results strongl support Hypothesis 1.

Hypothesis 2 predicted that participation in the structured community service intervention would significantly improve digital financial literacy among UMKM actors compared to that in the control group. Table 4 presents the pre- and post comparisons for the DFLI scores.

Table 4: Pre-Post Comparisons of Digital Financial Literacy Index (DFLI) Scores

Group	T1 M (SD)	T2 M (SD)	Mean Change	Paired t	p-value	Cohen's d
Intervention (n=118)	52.6 (10.3)	67.8 (11.2)	+15.2	16.31	<0.001	1.50
Control (n=118)	51.9 (9.8)	53.7 (10.1)	+1.8	2.04	0.044	0.19

The intervention group exhibited a marked and statistically significant improvement in digital financial literacy from T1 to T2, with mean DFLI scores

increasing from 52.6 to 67.8—an absolute improvement of 15.2 points representing a 28.9% increase relative to baseline. The effect size (Cohen's d = 1.50) exceededs the threshold for large effects and was among the largest observed in the study. The control group demonstrated a small but statistically significant improvement (mean increase = 1.8 points, p = 0.044), with a negligible effect size (d = 0.19).

ANCOVA results confirmed a significant main effect of group assignment on T2 DFLI scores after controlling for baseline values, $F(1, 233) = 168.45$, $p < 0.001$, partial $\eta^2 = 0.42$. The adjusted mean T2 DFLI score for the intervention group (67.6) was significantly higher than that of the control group (53.9), with a mean difference of 13.7 points (95% CI: 11.6 15.8). These findings provide robust support for Hypothesis 2.

Hypothesis 4 predicted that fintech adoption would positively influence business performance metrics among UMKM actors. Table 5 presents the pre-post comparisons for monthly revenues and operational efficiency.

Table 5: Pre-Post Comparisons of Business Performance Metrics

Variable / Group	T1 M (SD)	T2 M (SD)	Mean Change	% Change	Paired t	p-value
Monthly Revenue (IDR million)						
Intervention (n=118)	8.4 (5.2)	9.8 (5.6)	+1.4	+16.7%	3.82	<0.001
Control (n=118)	8.1 (4.9)	8.3 (5.1)	+0.2	+2.5%	1.14	0.257
Operational Efficiency Score						
Intervention (n=118)	2.8 (0.9)	3.7 (0.8)	+0.9	+32.1%	11.27	<0.001
Control (n=118)	2.9 (0.8)	3.0 (0.9)	+0.1	+3.4%	1.52	0.131

The intervention group demonstrated a significant increase in monthly revenue from Rp8.4 million to Rp9.8 million an absolute increase of Rp1.4 million representing a 16.7% improvement ($p < 0.001$). The control group exhibited a non-significant increase of 2.5% ($p = 0.257$). Improvements in operational efficiency were even more pronounced,

with intervention group scores rising from 2.8 to 3.7— 32.1% increase ($p < 0.001$) while control group scores remained essentially unchanged ($p = 0.131$).

Hypothesis 3 predicted that improvements in digital financial literacy would mediate the relationship between intervention participation and fintech adoption. Mediation analysis was conducted using the PROCESS macro (Model 4) with 5,000 bootstrap samples.

The mediation analysis revealed a significant indirect effect of intervention participation on fintech adoption through improvement in digital financial literacy (indirect effect = 0.24, SE = 0.03, 95% CI [0.18, 0.30]). The direct effect of intervention participation on fintech adoption remained significant (direct effect = 0.24, SE = 0.07, 95% CI [0.10, 0.38]), indicating a partial mediation. The total effect of intervention participation on fintech adoption was 0.48 (SE = 0.06, 95% CI [0.36, 0.60]). The proportion of the total effect mediated by digital financial literacy improvement was 50.0% (0.24 / 0.48). These findings support Hypothesis 3, indicating that approximately half of the intervention's effect on fintech adoption operates through the enhancement of digital financial literacy competencies.

Hypothesis 5 predicted that the intervention effects would be moderated by participant characteristics including business size, sector, and baseline digital proficiency. Table 6 presents the results of the hierarchical multiple regression analyses examining the interaction effects.

Table 6: Moderation Analysis of Intervention Effects on ΔFAI

Predictor	B	SE	β	t	p-value	ΔR^2
Step 1: Main Effects						0.41***
Group (Intervention = 1)	10.82	1.02	0.58	10.61	<0.001	
Baseline Digital Proficiency	1.24	0.51	0.09	2.43	0.016	
Business Size (Small = 1)	0.86	0.73	0.04	1.18	0.239	
Step 2: Interaction Terms						0.06**
Group × Digital Proficiency	2.18	0.68	0.22	3.21	0.002	
Group × Business Size	1.94	0.97	0.14	2.00	0.047	

Predictor	B	SE	β	t	p-value	ΔR^2
Group × Food Sector	-1.82	0.84	-0.12	-2.17	0.031	

*Note: B = unstandardized coefficient SE = standard error and β = standardized coefficient. ***p < 0.001, *p < 0.01.

Moderation analysis revealed several significant interaction effects. The Group × Digital Proficiency interaction was significant (β = 0.22, p = 0.002), indicating that the intervention s effects on fintech adoption were stronger among participants with higher baseline digital proficiency. Specifically, participants with advanced baseline proficiency exhibited a mean ΔFAI of 15.2 points, compared to 12.8 points for intermediate proficiency and 9.4 points for basic proficiency. The Group × Business Size interaction was also significant (β = 0.14, p = 0.047), suggesting that small enterprises (mean ΔFAI = 14.1 points) benefited more substantially from the intervention than micro enterprises (mean ΔFAI = 11.6 points). Additionally, a significant Group × Food Sector interaction emerged (β = -0.12, p = 0.031), indicating that participants in the food and beverage sector experienced smaller intervention effects than those in other sectors, possibly reflecting sector-specific operational constraints or lower perceived relevance of certain digital financial tools.

Discussion

The present study yields several substantive findings that advance the understanding of fintech optimization and digital financial literacy enhancement among Indonesian UMKM. The robust and statistically significant improvements observed in both fintech adoption (ΔFAI = +12.4 points, d = 1.36) and digital financial literacy (ΔDFLI = +15.2 points, d = 1.50) among intervention group participants provide compelling evidence that structured, participatory community service interventions can effectively accelerate MSME digital transformation. These effect sizes substantially exceed those typically reported in educational and behavioral interventions, suggesting that the combination of hands-on training, peer interaction, and facilitator guidance constitutes a particularly potent mechanism for enhancing digital financial capabilities among small business actors (Abdusalam & Kaniawati, 2026).

The magnitude of improvement in fintech adoption observed in this study (30.1% relative to the baseline) compares favorably with the outcomes documented in previous community service initiatives. For instance, the GENCARKAN program implemented by the OJK reached over 70,510 participants in 2025 but did not report quantitative pre-post measures of behavioral change. The present study thus contributes novel empirical evidence on the efficacy of such interventions, establishing benchmarks against which future programs can be evaluated. The finding that the control group exhibited only marginal improvement (ΔFAI = +1.6 points, d = 0.20) despite access to comprehensive self-guided learning materials underscores the limitations of purely informational approaches to digital financial empowerment. This result aligns with adult learning

theory, which emphasizes the centrality of experiential learning, social interaction, and guided practice in developing practical competencies and behavioral changes.

The mediation analysis revealing that digital financial literacy improvement accounts for approximately 50% of the intervention's effect on fintech adoption provides important theoretical and practical insights. This finding corroborates and extends previous research demonstrating that digital financial literacy, rather than traditional financial literacy, significantly influences fintech adoption decisions among Indonesian UMKM. The partial mediation observed suggests that intervention participation influences fintech adoption through multiple pathways: directly, by providing practical assistance in activating and using specific fintech tools and indirectly, by enhancing the cognitive and behavioral competencies that enable participants to independently navigate the digital financial ecosystem. This dual mechanism has important implications for intervention design, suggesting that effective programs must address both the "how" (technical skills) and the "why" (conceptual understanding and risk awareness) of fintech utilization (Anggraini et al., 2025).

The significant improvements in business performance metrics—a 16.7% increase in monthly revenue and a 32.1% improvement in operational efficiency—among intervention participants provide tangible evidence of the economic returns associated with fintech optimization and digital financial literacy enhancement. These findings are consistent with survey evidence indicating that over 50% of UMKM using fintech lending for productive purposes report increased business income. However, the present study extends this correlational evidence by demonstrating the ausal effects within a controlled experimental design. The substantially larger improvement in operational efficiency (32.1%) compared to revenue (16.7%) suggests that the immediate benefits of digital financial tools manifest primarily through enhanced administrative efficiency—reduced time spent on manual transaction processing, improved record-keeping accuracy, and streamlined customer payment experiences—which may in turn create conditions conducive to revenue growth over longer time horizons. This temporal sequencing aligns with the innovation diffusion literature, wherein efficiency gains often precede and enable growth-oriented outcomes.

The findings of this study contribute to several theoretical perspectives. First, the results provide strong empirical support for the applicability of the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) in explaining fintech adoption among Indonesian UMKM. The intervention's emphasis on hands-on practice with digital financial tools likely enhanced participants' perceptions of both ease of use and usefulness, thereby increasing their behavioral intention and actual adoption. The finding that the intervention effects were stronger among participants with higher baseline digital proficiency is consistent with UTAUT's emphasis on facilitating conditions and individual differences as moderators of technology acceptance (Suwardi et al., 2025).

Second, thise study advances the conceptualization and measurement of digital financial literacy as a multidimensional construct encompassing knowledge, skills, attitudes, and behaviors. The DFLI instrument developed for this study, which demonstrated acceptable reliability and sensitivity to change, offers a validated tool for future research examining digital financial literacy in the Indonesian UMKM context. The differential effects observed across DFLI dimensions—with particularly large

improvements in the skills and behaviors dimensions (data not shown in tables due to space constraints)—suggest that community service interventions may be especially effective in translating abstract knowledge into practical competencies and habitual behaviors.

Third, the mediation findings contribute to the emerging literature on the mechanisms linking financial literacy interventions to behavioral result. The partial mediation observed indicates that digital financial literacy enhancement is a necessary but insufficient condition for optimizing fintech adoption. The significant direct effect of intervention participation suggests that additional mechanisms potentially including social learning, peer influence, and facilitated access to technology operate independently of measured literacy improvements. Future research employing qualitative methods may help to elucidate these complementary pathways.

The findings of this study have direct implications for the design and implementation of community service programs aimed at UMKM digital empowerment. Several evidence-based recommendations have emerged from these results.

Emphasis on Hands-On Experiential Learning: The large effect sizes observed for the intervention group, contrasted with the negligible improvements in the control group, underscore the critical importance of experiential, facilitator-guided learning. Community service programs should prioritize hands-on practice sessions in which participants actively use FinTech applications under facilitator supervision rather than relying primarily on didactic presentations or self-guided materials. The provision of individualized assistance in account activation, transaction execution, and troubleshooting—as implemented in Module 2 of the present intervention—appears to be a particularly high-yield component (Trivena et al., 2026).

Integration of Digital Financial Literacy and Fintech Optimization: The mediation findings indicate that digital financial literacy enhancement and optimization of fintech adoption are complementary rather than alternative intervention targets. Programs should explicitly address both domains, ensuring that participants not only learn how to use specific fintech tools but also develop broader competencies—including risk awareness, consumer protection knowledge, and strategic financial planning—necessary to utilize digital financial services effectively and safely over the long term.

Segmentation and Tailoring: Moderation analysis revealed that the intervention effects varied significantly across participant subgroups. Participants with higher baseline digital proficiency and those operating small (rather than micro) enterprises exhibited greater improvements, suggesting that a one-size-fits-all approach may be suboptimal. Community service programs should consider segmenting participants by baseline digital proficiency and business size and tailoring content and delivery methods accordingly. For participants with limited digital proficiency, additional foundational training in smartphone navigation and basic digital literacy may be warranted prior to introducing fintech-specific content.

Sector-Specific Adaptation: The finding that food and beverage sector participants experienced smaller intervention effects suggests that sector-specific operational contexts influence the relevance and applicability of certain digital financial tools. Program curricula should be adapted to reflect sector-specific business processes, transaction patterns and customer interactions. For instance, food and beverage UMKM

may benefit from specialized modules addressing QRIS integration with point-of-sale systems, inventory management applications tailored to perishable goods, and digital marketing strategies for food products.

Sustainability and Follow-Up: The four-week follow-up period employed in this study, while longer than many community service evaluations, remains relatively short for assessing sustained behavioral changes and business impact. Program desig nersshould incorporate mechanisms for ongoing support and reinforcement, including peer learning networks, refresher training sessions, and digital communication channels for troubleshooting and consultation. Partnerships with local cooperative and SME agencies can facilitate continued engagement beyond the temporal boundaries of university-led projects.

The findings of this study resonate with broader national policy objectives regarding financial inclusion and the digital transformation. The documented efficacy of community service interventions in enhancing fintech adoption and digital financial literacy among UMKM suggests that higher education institutions can serve as strategic implementation partners in achieving the government's ambitious financial inclusion targets of 93% by 2029 and 98% by 2045. Several policy implications warrant consideration in this regard.

Scaling Community Service Programs: The present study demonstrates that well-designed community service interventions can substantiall improve digital financial outcomes among UMKM. However, the current scale of such programs—exemplified by OJK's GENCARKAN reaching 70,510 participants in 2025—remains modest relative to Indonesia's 65.5 million UMKM. Policy initiatives that incentivize and resource expanded community service programming, potentially through competitive grant mechanisms, performance-based funding for universities, or public-private partnerships, could accelerate the diffusion of digital financial capabilities across the UMKM sector.

Integration with National Digital Literacy Frameworks: The DFLI instrument developed for this study aligns with the competency domains outlined in the National Strategy for Financial Literacy 2021-2025, which identifies UMKM as a priority target segment. Policy coordination between the Ministry of Education, OJK, and Bank Indonesia could facilitate the adoption of standardized measurement instruments across community service programs, enabling the systematic monitoring and evaluation of intervention effectiveness at the national level.

Addressing Regional Disparities: The study's location in East Java, while providing a diverse sample, does not address the pronounced regional disparities in financial inclusion documented in the SNLIK data, wherein eastern Indonesian provinces such as Papua and NTT lag substantially behind Java. Policy interventions should prioritize the deployment of community service programs in underserved regions, potentially through targeted funding allocations and partnerships with universities in Eeastern Indonesia.

Society 5.0 Readiness: The Society 5.0 paradigm envisions a data-driven economy wherein UMKM's competitive advantage derives from their capacity to generate, analyze, and leverage digital data. The findings suggest that community service interventions can accelerate UMKM's transition from cash-based, informal operations to digitized, data-generating business models. Policymakers should consider how

community service programs can be leveraged to enhance basic digital financial inclusion and prepare UMKM for more advanced data analytics, artificial intelligence applications, and platform economy participation characteristics of Society 5.0.

Several limitations of the present study should be acknowledged, each pointing to directions for future research that should be considered. First, although the quasi-experimental design is methodologically robust, it cannot fully eliminate threats to internal validity arising from potential confounding variables. The random assignment of participants to groups mitigates many such threats however,the community-based nature of the research precluded the blinding of participants and facilitators, introducing potential expectancy effects. Future research employing randomized controlled trials with blinded outcome assessors will provide even stronger causal evidence.

Second, the four-week follow-up period, while appropriate for assessing immediate intervention effects, was insufficient for evaluating the long-term sustainability of observed improvements. Longitudinal studies tracking participants over 6-12 months post-intervention are needed to determine whether initial gains in fintech adoption and digital financial literacy persist, attenuate, or compound over time. Such studies could also examine whether the revenue improvements observed in the present study represent transient effects or the beginning of a sustained business growth trajector.

Third, reliance on self-reported outcome measures, particularly for business revenue, introduces potential reporting biases. While triangulation with available financial records was conducted where possible, future research should explore the feasibility of integrating objective data sources such as transaction records from QRIS or digital banking platforms as outcome measures, subject to appropriate data privacy and consent protocols.

Fourth, the study's geographic focus on East Java limits its generalizability to other Indonesian regions with distinct economic, cultural, and infrastructural characteristics. Multi-site studies encompassing diverse regional contexts are needed to assess the external validity of the intervention model and identify contextual factors that moderate intervention effectiveness.

Fifth, this study did not examine the cost-effectiveness of the community service intervention relative to alternative approaches to UMKM digital empowerment. Given the resource constraints facing higher education institutions and government agencies, economic evaluations—including cost-benefit analysis and return-on-investment calculations—would inform resource allocation decisions and program prioritization

CONCLUSION

This study provides robust quantitative evidence that structured community service interventions can significantly enhance fintech adoption and digital financial literacy among Indonesian UMKM, with tangible downstream effects on business revenue and operational efficiency of UMKM. The 30.1% improvement in fintech adoption and 28.9% increase in digital financial literacy observed among intervention participants substantially exceed ed the negligible improvements in the self-guided control group, underscoring the critical importance of hands-on, facilitator-guided

experiential learning in digital financial empowerment initiatives. The finding that digital financial literacy improvement mediates approximately half of the intervention's effect on fintech adoption illuminates a key mechanism through which community service programs catalyze behavioral changeThe significant moderation effects highlight the need for tailored approaches that account for participants' baseline digital proficiency and sectoral contexts. The implications of these findings extend beyond the immediate study context to inform the national policy discourse on financial inclusion and Society 5.0 readiness. As Indonesia pursues ambitious targets of 93% financial inclusion by 2029, community service programs implemented by higher education institutions represent a scalable and demonstrably effective mechanism for accelerating UMKM digital transformation. The integration of such programs within a coordinated national strategy—encompassing standardized measurement, regional prioritization, and multi-stakeholder partnerships—could substantially enhance Indonesia's progress toward an inclusive digital economy in which UMKM are not merely participants but active beneficiaries of Society 5.0. Future research should extend the present findings through longitudinal evaluations of intervention sustainability, multi-site replication across diverse regional contexts, and economic analyses of program cost-effectiveness. The development of objective, transaction-based outcome measures would further strengthen the evidence base for community service interventions in the digital finance domain. Ultimately, the continued refinement and scaling of evidence-based community service programs holds promise for empowering Indonesia's 65.5 million UMKM to navigate and thrive in the digital financial ecosystem of the Society 5.0 era.

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