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How Literacy and Savings Link Digital Finance to Sustainability?

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Abstract

This study analyzes how digitalization, financial inclusion, and financial literacy affect business savings and the sustainability of culinary Micro, Small, and Medium Enterprises (MSMEs) in Central Java, Indonesia. Data from 210 MSME owners were examined using Partial Least Squares–Structural Equation Modeling (PLS-SEM). The results show that digitalization and financial inclusion significantly increase business savings, thereby enhancing MSME sustainability. Financial literacy does not directly affect sustainability but moderates the relationship between savings and sustainability, strengthening the effectiveness of savings utilization. The model shows strong explanatory power, with R^2 values of 0.37 for business saving and 0.90 for sustainability. The Importance–Performance Map Analysis identifies financial literacy and digitalization as highly important yet moderately performing variables, marking them as priorities for policy development. Overall, the findings highlight that MSME sustainability in Central Java depends on integrating digital finance, inclusive access, and sound saving behavior, supported by financial literacy. The study provides policymakers and financial institutions with practical insights for designing integrated digital finance and literacy programs that strengthen MSME resilience and regional economic growth.

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INTRODUCTION

Culinary micro, small, and medium enterprises (MSMEs) in Central Java have become an essential pillar of Indonesia's economic development. They contribute more than 60% of the national GDP and employ over 96% of the workforce, reflecting their vital role in employment creation and community welfare (Mustofa et al., 2023; Rahardjo, Daryono, 2024). Beyond their economic contribution, culinary MSMEs serve as agents of innovation and cultural preservation, strengthening local competitiveness and resilience during periods of economic uncertainty (Triwahyono, Rahayu, and Kraugusteeliana, 2023). However, the sustainability of these enterprises remains challenging due to limited access to finance, weak managerial capacity, and low levels of digital technology adoption. Many business owners continue to rely on informal financing and lack structured business-saving practices, limiting their ability to grow and withstand financial shocks (Kumalasari and Farida, 2024; Sutrisno, 2023).

The rapid development of financial technology offers MSMEs opportunities to overcome these limitations. Digital financial services, such as mobile banking, e-wallets, and online payment systems, have simplified transactions, improved financial management, and reduced operational costs, enabling entrepreneurs to manage cash flows more effectively (Komariyah, 2024; Rahawarin, Soetjipto, and Wardoyo, 2023). The integration of digital platforms also supports transparent bookkeeping and facilitates pro-business behavior through accessible, low-cost financial mechanisms. Digital financial services improve cash-flow visibility and record accuracy, reducing cash leakage and enabling entrepreneurs to allocate surplus funds more effectively into business reserves (Komariyah, 2024; Fitrianti, Fatmawati, and Zaenal, 2023). Likewise, digital payment systems reduce transaction frictions and strengthen the separation between business and household finances, thereby encouraging more disciplined saving practices and greater retention of funds within formal financial institutions (Ummasyroh et al., 2024; Rahawarin, Soetjipto, and Wardoyo, 2023). Empirical evidence further indicates that financial digitalization enhances business savings while reducing operational costs among MSMEs, suggesting that efficiency gains translate into greater financial reserves (Jirwanto, 2024). Consequently, digitalization has emerged as an important driver of MSME competitiveness and financial discipline (Fitrianti, Fatmawati, and Zaenal, 2023; Ummasyroh et al., 2024). Nevertheless, these benefits can be fully realized only when MSME owners possess sufficient financial literacy to use digital financial tools strategically (Hamid et al., 2024).

Financial inclusion also plays a significant role in fostering MSME growth. Access to formal financial services—including savings accounts, microcredit, and digital payment systems—enables small businesses to accumulate capital and reinvest profits for expansion (Noor, Batool, and Arshad, 2020; Ratnawati, 2020). Inclusive finance strengthens enterprises' financial foundations by encouraging disciplined saving behavior while reducing reliance on informal lenders. In rural and semi-urban areas of Central Java, greater financial inclusion helps bridge the gap between traditional business practices and modern financial systems, thereby promoting more equitable economic opportunities (Dewi and Wiksuana, 2023). However, access alone is insufficient; effective use of financial services requires adequate financial literacy and digital competence (Ozili, 2020; Risman, 2024).

Financial literacy enhances entrepreneurs' understanding of budgeting, saving, and investment decisions (Sulistyowati, Pranoto, and Mas'adah, 2024; Yanto, Kiswanto, et al., 2022). Business owners with higher financial literacy allocate resources more efficiently, establish clearer financial goals, and maintain stronger financial discipline (Zaniarti et al., 2022). Financial literacy also strengthens their ability to assess risks, plan for uncertainty, and use digital tools to monitor cash flows (Rahmawati, Thaha, Nurwulandari, 2023). Consequently, financial literacy not only shapes financial behavior but may also strengthen the influence of business savings and financial inclusion on enterprise sustainability (Ratnawati et al., 2023). MSMEs that combine saving discipline with literacy are more likely to achieve long-term stability and innovation capacity.

Business savings constitute an important internal financial resource that enables enterprises to finance operational activities and investments without excessive dependence on external financing (Rikwentishe, Musa Pulka, and Msheliza, 2015; Damayanti et al., 2024). Within the Resource-Based View (RBV), internally generated financial reserves are valuable strategic resources because they enhance a firm's resilience, its ability to exploit opportunities, and its capacity to adapt to uncertainty (Lee and Chen, 2022; Agrawal et al., 2024). From this perspective, financial digitalization and financial inclusion function as enabling conditions that facilitate resource accumulation by improving transaction efficiency, expanding access to formal saving instruments, and strengthening firms' ability to retain and mobilize financial reserves. Financial literacy, in turn, represents a managerial capability that determines how effectively these internal resources are managed and allocated, thereby influencing whether accumulated savings translate into sustainable performance. Consistent with this perspective, business savings provide a financial buffer that enables MSMEs to withstand crises, invest in innovation, and sustain employment. Previous studies have likewise shown that business savings mediate the relationship between financial access and firm sustainability (Hererra, Warokka, and Aqmar, 2023; Widagdo and Sa'diyah, 2023).

Although previous studies increasingly recognize financial digitalization and financial inclusion as important drivers of MSME development, empirical evidence remains fragmented regarding the mechanisms through which these factors influence enterprise sustainability, particularly among resource-constrained firms. Recent reviews indicate that micro and small enterprises continue to face persistent barriers to adopting sustainable business practices due to limited financial resources and organizational capabilities, highlighting the need for context-specific mechanisms explaining how financial resources are accumulated and deployed over time (Becerra-Bizarrón and Gomez-Bernal, 2025). Moreover, studies examining SME performance rarely integrate entrepreneurs' financial capabilities into a comprehensive explanation of firm-level financial behavior and sustainability outcomes (Diéguez-Soto et al., 2021; Kryeziu et al., 2023). Accordingly, this study addresses these research gaps by conceptualizing MSME sustainability as the outcome of a resource–capability interaction. Financial digitalization and financial inclusion are proposed as enabling conditions that facilitate the accumulation of internal financial reserves through business savings.

In contrast, financial literacy represents the capability that determines how effectively those reserves are transformed into sustainable business performance. Rather than emphasizing novelty solely through mediation and moderation analysis, this study explains why digital finance and financial inclusion contribute to sustainability only when they generate an internal financial buffer and when entrepreneurs possess sufficient financial capability to allocate and utilize those savings strategically. This integrated perspective is particularly relevant for culinary MSMEs, where volatile cash flows, perishable inventories, and frequent reliance on informal transactions complicate liquidity management and increase vulnerability to short-term shocks. Under these conditions, business savings become a critical internal buffer for stabilizing operations and financing reinvestment. At the same time, financial literacy enables entrepreneurs to separate business and household finances, manage inventory expenditures, and allocate savings strategically to sustain long-term business performance (Putri and Husna, 2024).

Central Java provides an important empirical setting for examining these relationships. The province hosts numerous culinary clusters that are increasingly adopting digital payment systems and e-commerce platforms to expand market access. Nevertheless, disparities in financial literacy and financial inclusion persist between urban and rural areas (Haqqi, 2023). Although local governments have implemented digital financial education and MSME digitalization programs, their effectiveness in improving business savings and enterprise sustainability has not yet been empirically evaluated (Sari and Anggraweni, 2024). Examining these relationships is therefore essential for developing evidence-based policies that promote inclusive and sustainable MSME development.

Based on this background, the present study examines the effects of financial digitalization, financial inclusion, and financial literacy on business savings and the sustainability of culinary MSMEs in Central Java. Specifically, business savings are proposed as a mediating mechanism linking financial access and digital transformation to sustainable business performance. In contrast, financial literacy is examined as a moderating capability that strengthens this relationship. Using Partial Least Squares–Structural Equation Modeling (PLS-SEM), this study provides empirical evidence on the mechanisms by which digital finance and financial inclusion contribute to MSME sustainability via business-saving behavior.

This study contributes to the literature by specifying and empirically testing an integrated resource–capability framework in which financial digitalization and financial inclusion influence MSME sustainability through business savings, while financial literacy conditions the effectiveness of this mechanism among culinary MSMEs in Central Java. From a practical perspective, the findings provide evidence to support the design and evaluation of MSME development programs that promote digital financial adoption, strengthen financial inclusion, enhance financial literacy, and foster long-term business sustainability.

RESEARCH METHODS

This study employs a quantitative explanatory research design to examine the structural relationships among financial digitalization, financial inclusion, financial literacy, business savings, and business sustainability within culinary Micro, Small, and Medium Enterprises (MSMEs) in Central Java, Indonesia, using cross-sectional survey data.

A quantitative explanatory design was selected because it enables the empirical testing of hypothesized relationships and the estimation of the magnitude of direct, indirect, and moderating effects among latent constructs (Hair, 2021). The study specifically investigates the mediating role of business savings and the moderating role of financial literacy, providing a comprehensive understanding of how digital financial mechanisms and financial capabilities contribute to business sustainability. The proposed research framework is grounded in behavioral finance theory and the Resource-Based View (RBV), which explains how internal financial management capabilities and access to digital financial systems enhance firm resilience and long-term sustainability.

The study population consists of culinary MSME owners operating in three regencies in Central Java—Semarang, Grobogan, and Klaten. These locations were purposively selected to represent contrasting business environments, including an urban hub, a rural/agro-based area, and a peri-urban district, as well as varying levels of digital financial adoption among culinary MSMEs. This regional variation provides a more contextually grounded examination of the proposed structural relationships within the Central Java setting.

A purposive sampling technique was employed to recruit culinary MSME owners who met predefined inclusion criteria: actively operating in the culinary sector and having prior experience with digital financial services relevant to the study's constructs. Purposive sampling was considered appropriate because it enables researchers to select information-rich cases that best address the study's analytical objectives, particularly when the target population is heterogeneous and probability sampling is difficult to implement (Magnone & Yezierski, 2024). After data screening, 210 valid responses were retained for analysis.

Nevertheless, because the sample was obtained through purposive (non-probability) sampling and intentionally included only culinary MSMEs with prior exposure to digital financial services, the findings should be interpreted as representing digitally engaged culinary MSMEs rather than the broader population of culinary MSMEs. This sampling strategy may introduce selection bias by excluding financially excluded or digitally inactive enterprises, thereby limiting the statistical generalizability of the findings (McEwan, 2020; Vaithilingam *et al.*, 2024).

Primary data were collected through structured questionnaires administered both online and offline in 2025. The questionnaire comprised two sections: respondent demographic profiles and measurement items for the latent constructs. All constructs were measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). To complement the survey data and provide richer contextual insights, short semi-structured interviews were conducted with ten MSME owners regarding their experiences with digital financial services and business saving practices. Participation was voluntary, informed consent was obtained from all respondents, and confidentiality was maintained throughout the research process. The operational definitions of the variables, together with their indicators and measurement scales, are presented in Table 1.

Table 1. Operational Variable Definition

Variables	Operational Definition	Indicator	Source
Financial Digitalization (FD)	The extent to which MSMEs adopt digital financial services and technology to manage transactions, savings, and business operations efficiently.	1. Usage of mobile banking 2. Digital payment adoption 3. Transaction efficiency 4. Access to digital platforms 5. Digital service reliability	Rahawarin, Soetjipto, and Wardoyo (2023); Fitrianti, Fatmawati, and Zaenal (2023); Komariyah (2024)
Financial Inclusion (FI)	Access of MSMEs to formal financial services, including credit, savings, and other financial products, to support business operations.	1. Access to financial institutions 2. Ownership of savings/credit accounts 3. Availability of financial products 4. Utilization of banking services 5. Trust in financial institutions	Noor, Batool, and Arshad (2020); Ratnawati (2020); Tubastuvi and Rusydiana (2024);
Financial Literacy (FL)	The knowledge, ability, and attitude of MSME owners in managing finances, understanding financial products, and making informed financial decisions.	1. General financial knowledge 2. Budgeting and financial planning 3. Risk and investment understanding 4. Saving behavior 5. Financial decision-making capability	Yanto, Kiswanto, *et al.* (2022); Zaniarti, Veronica and Arsytania (2022); Hamid *et al.* (2024); Sulistyowati, Pranoto and Mas'adah (2024);
Business Saving (BS)	Portion of MSME income reserved for future investment, emergencies, and business development to ensure financial stability.	1. Saving frequency 2. Saving objectives 3. Saving consistency 4. Reinvestment proportion 5. Saving utilization flexibility	Rikwentishe, Musa Pulka, and Msheliza (2015); Nassuna *et al.* (2023); Widagdo and Sa'diyah (2023); Damayanti *et al.* (2024);
Business Sustainability (S)	The ability of MSMEs to maintain and grow their operations through innovation, efficiency, and resilience under changing economic conditions.	1. Business continuity 2. Profit growth 3. Innovation capability 4. Employee stability 5. Market competitiveness	Hererra, Warokka and Aqmar (2023); Hamid *et al.(*2024); HS *et al.* (2024); Nurkhamid, (2025);

Source: Data Processed (2025)

The data collection process employed Google Forms for online distribution and printed questionnaires for respondents in rural areas with limited internet access. Enumerators were trained to assist participants in understanding items related to digital financial services, thereby minimizing potential misinterpretation. Each completed questionnaire was reviewed for completeness before data entry. The responses were subsequently coded and analyzed using SmartPLS version 3.0.

Common Method Bias Assessment. Because all variables were measured using self-reported questionnaires collected from a single source at one point in time, this study considered the potential risk of common method bias (CMB), which may inflate observed relationships in survey-based research (Kock, Berbekova, & Assaf, 2021). Following recommendations for PLS-SEM (Hair et al., 2022), collinearity diagnostics were performed by examining variance inflation factor (VIF) values. Inner VIF values were assessed at the structural model level to evaluate collinearity among predictor constructs. In contrast, outer VIF values were examined at the indicator level to detect potential multicollinearity within the measurement model. In addition, discriminant validity and predictive relevance (Q^2) were evaluated as complementary assessments to ensure that the observed relationships reflected substantive associations rather than methodological artifacts. The results of these diagnostic tests are presented in the Results section.

The mathematical representation of the research model is as follows:

$BS = \beta_1 FD + \beta_2 FI + \varepsilon_1$ .... (1)

$S = \beta_3 BS + \beta_4 FL + \beta_5 (BS \times FL) + \varepsilon_2$ .... (2)

Indirect effects:

$FD \rightarrow BS \rightarrow S = (\beta_1 \times \beta_3)$ .... (3)

$FI \rightarrow BS \rightarrow S = (\beta_2 \times \beta_3)$ .... (4)

Where FD denotes Financial Digitalization, FI denotes Financial Inclusion, FL denotes Financial Literacy, BS denotes Business Saving, S denotes Business Sustainability, and BS × FL represents the interaction term capturing the moderating effect of financial literacy on the relationship between business saving and business sustainability. These equations are consistent with the hypothesized direct relationships (FD → BS, FI → BS, BS → S, and FL → S), the moderation effect (BS × FL → S), and the mediation pathways presented in the hypothesis development.

Financial literacy was modeled as a moderator of the relationship between business savings and business sustainability by incorporating the interaction term (BS × FL) into the structural model. This specification is grounded in the premise that business saving represents an internal financial resource, whereas financial literacy reflects a managerial capability that determines how effectively financial resources are planned, safeguarded, and allocated (Lee and Chen, 2022; Agrawal *et al.*, 2024). Accordingly, higher levels of financial literacy are expected to strengthen the extent to which accumulated business savings are translated into sustainability outcomes through more effective budgeting, improved allocation between operational reserves and reinvestment, and higher-quality financial decision-making under conditions of uncertainty (Alshebami and Marri, 2022). The moderation effect was estimated within the PLS-SEM framework by constructing the interaction term and simultaneously testing its effect alongside the main effects, following established procedures for interaction modeling in variance-based structural equation modeling (Voss, 2023; Hair *et al.*, 2022). The moderation results are presented in the Results section.

The hypotheses were formulated based on established theoretical arguments and prior empirical findings. The proposed positive relationship between financial digitalization and business saving (H1) is supported by studies showing that digital financial technologies improve transaction efficiency and promote saving behavior among MSMEs (Komariyah, 2024; Rahawarin, Soetjipto, and Wardoyo, 2023; Fitrianti, Fatmawati, and Zaenal, 2023). The relationship between financial inclusion and business savings (H2) is grounded in evidence demonstrating that access to formal financial services increases the capacity of small enterprises to accumulate savings and reinvest profits (Noor, Batool, and Arshad, 2020; Tubastuvi and Rusydiana, 2024). The positive influence of business savings on business sustainability (H3) aligns with previous findings that consistent saving behavior enhances MSME resilience and long-term growth (Damayanti et al., 2024; Nassuna *et al.*, 2023). The mediating role of business saving (H4–H5) builds on studies that identify saving as a financial mechanism linking financial inclusion and digitalization with sustainable business performance (Rikwentishe, Musa Pulka, and Msheliza, 2015; Widagdo and Sa'diyah, 2023; Hererra, Warokka, and Aqmar, 2023). Finally, the moderating role of financial literacy (H6) is supported by evidence indicating that financially literate entrepreneurs utilize savings and digital financial services more effectively to achieve sustainable business outcomes (Yanto, Kiswanto, *et al.*, 2022; Zaniarti, Veronica, and Arsytania, 2022; Hamid *et al.*, 2024).

Data analysis was conducted in two stages. First, the measurement model (outer model) was evaluated to establish the validity and reliability of the latent constructs. Indicator reliability was assessed using factor loadings exceeding 0.70, while construct reliability was evaluated through Cronbach's alpha and composite reliability values above 0.70. Convergent validity was established using the average variance extracted (AVE), which exceeded the recommended threshold of 0.50. Discriminant validity was assessed using the Fornell–Larcker criterion and cross-loading comparisons.

Second, the structural model (inner model) was evaluated by examining path coefficients, coefficients of determination (R^2), and t-statistics obtained through the bootstrapping procedure (Sarstedt and Moisescu, 2024). Model fit was assessed using the standardized root mean square residual (SRMR), with values below 0.08 indicating an acceptable model fit. Predictive relevance of the endogenous constructs was evaluated using the blindfolding procedure to obtain Stone–Geisser's Q^2 values, which indicate whether the model possesses predictive capability beyond its explanatory power (Hair *et al.*, 2022). The results of the blindfolding are reported in the Results section.

Given that explanatory measures such as R^2 may appear relatively high in survey-based models, particularly when constructs are conceptually related or share common variance, the structural model evaluation was complemented with several robustness diagnostics recommended in current PLS-SEM reporting guidelines (Sarstedt *et al.*, 2020; Hair *et al.*, 2022). First, potential collinearity among predictor constructs was assessed using inner variance inflation factor (VIF) values to minimize the risk of inflated parameter estimates resulting from overlapping explanatory information (Hair *et al.*, 2022). Second, the model's predictive capability was further examined using prediction-oriented procedures, including out-of-sample prediction assessment, to complement explanatory performance with predictive evidence (Sharma *et al.*, 2022). Third, effect size (f^2) values were evaluated to determine the substantive contribution of each exogenous construct beyond statistical significance alone (Hair *et al.*, 2022). The results of these robustness analyses are presented in the Results section.

To further identify priority factors influencing MSME sustainability, an Importance–Performance Map Analysis (IPMA) was conducted. IPMA combines the total effects (importance) of predictor constructs with their average latent variable scores (performance) to identify constructs that offer the greatest opportunities for managerial and policy improvement. Constructs that are highly important but relatively low-performing, such as financial literacy and financial digitalization, represent strategic priorities for intervention (Sarstedt *et al.*, 2020). Descriptive statistics were also used to summarize respondents' demographic and business characteristics, including age, educational attainment, business tenure, and average business savings, thereby providing contextual support for interpreting the empirical findings.

Overall, this methodological approach enhances the study's transparency, rigor, and replicability. By integrating validated measurement instruments, systematic data collection procedures, and advanced PLS-SEM analytical techniques, this research provides robust empirical evidence regarding the roles of financial digitalization, financial inclusion, financial literacy, and business savings in promoting the sustainability of culinary MSMEs.

RESULTS AND DISCUSSION

The characteristics of the respondents are shown in Table 2. This table presents the demographic and business characteristics of the culinary MSME owners participating in the study, including age, educational attainment, business tenure, and business savings. The sample exhibits a relatively balanced age distribution, with approximately one-third of respondents aged 35-45 years and one-third aged 45+ years. Most respondents (approximately 95%) have a high school education or lower, whereas only about 5% have completed tertiary education. Regarding business experience, nearly half of the MSMEs have operated for 1.5–2.5 years, while the remaining enterprises are relatively evenly divided between businesses operating for less than 1.5 years and those established for more than 2.5 years.

Business savings also vary across respondents. Approximately 40% of MSME owners report business savings of IDR 1.0-1.5 million, whereas the remaining respondents are distributed relatively evenly between savings below IDR 1.0 million and above IDR 1.5 million. These descriptive findings suggest that most culinary MSMEs operate with limited formal educational backgrounds and relatively modest financial reserves. Such characteristics provide important context for interpreting the relationships examined in this study, as lower educational attainment may increase reliance on personal financial experience and informal knowledge in managing business finances. Consequently, financial literacy is expected to play an increasingly important role in enabling MSME owners to utilize digital financial services effectively and manage business savings more strategically (Aribawa, 2016).

Table 2. Respondent profiles

Variables	Description	Frequency	(%)
Age (years)	<35	73	34.8
	35-45	65	31
	>45	72	34.2
Education	< High school	97	46.2
	High school	102	48.6
	graduate	11	5.2
Long time in business (years)	<1.5	45	21.4
	1.5-2.5	99	47.2
	>2.5	66	31.4
Business saving (Million Rp)	<1	46	21.9
	1-1.5	85	40.5
	>1.5	79	37.6

Source: Data processed, 2025

The SEM-PLS results presented in Table 3 indicate that both financial digitalization and financial inclusion have positive, statistically significant effects on business savings. Financial digitalization exerts a significant positive influence on business savings (β = 0.370, t = 2.635, p = 0.009), while financial inclusion demonstrates a similarly strong positive effect (β = 0.382, t = 3.994, p < 0.001).

Table 3. Hypothesis Testing

Path (hypothesis)	β	t-value	p-values
Financial literacy -> business sustainability	0.160	1.821	0.069
Moderating FL -> business sustainability	-0.210	7.698	0.000
business saving -> business sustainability	0.164	2.622	0.009
financial digitalization -> business saving	0.370	2.635	0.009
financial inclusion -> business saving	0.382	3.994	0.000
financial digitalization -> business saving -> business sustainability	0.060	1.781	0.076
financial inclusion -> business saving -> business sustainability	0.063	2.199	0.028

Source: Data processed, 2025

These findings validate that MSME owners who are digitally connected and financially included tend to accumulate greater business savings. Digital financial services simplify transactions, reduce costs, and encourage saving discipline through accessible platforms such as e-wallets and mobile banking (Komariyah, 2024; Rahawarin, Soetjipto, and Wardoyo, 2023). Inclusive finance strengthens this process by providing MSMEs with secure options for storing and managing funds, thereby reducing reliance on informal mechanisms (Ratnawati, 2020; Dewi and Wiksuana, 2023). This aligns with development finance perspectives emphasizing that digitalization provides the tools, while inclusion provides the opportunity, both enabling effective resource management (Baporikar and Akino, 2020; Ćumurović and Hyll, 2019). These mechanisms collectively enhance MSME financial capacity and set the foundation for sustainable operations.

Financial inclusion's positive relationship with saving supports the view that access to formal finance drives financial discipline and investment readiness (Rikwentishe, Musa Pulka & Msheliza, 2015; Millaningtyas et al., 2024). When MSMEs can access banking services, credit, and advisory programs, they are more likely to adopt structured saving behavior. This demonstrates the developmental role of inclusive finance in promoting long-term financial stability and entrepreneurial growth (Hamid et al., 2024). Empirical evidence from Central Java reinforces this point: MSMEs that integrate digital payment systems and formal savings accounts report improved cash-flow control and lower vulnerability to liquidity shocks (Jirwanto, 2024). Policy-wise, expanding digital banking infrastructure in semi-urban and rural districts is essential to ensure that inclusion benefits all MSME segments. Strengthening financial networks in collaboration with local cooperatives and fintech providers can facilitate broader participation in the formal economy and enhance internal saving mechanisms critical to sustainability.

Business savings show a significant positive effect on business sustainability (β = 0.164, t = 2.622, p = 0.009), confirming its mediating role in the structural model. MSMEs with consistent saving practices achieve greater operational stability and innovation capability, aligning with the argument that retained earnings serve as a vital internal capital source (Rikwentishe, Musa Pulka, and Msheliza, 2015; Damayanti et al., 2024). Savings provide financial buffers that support expansion, product development, and workforce continuity, particularly during crises. According to the pecking order theory, MSMEs often prefer to rely on internal funds before external credit, implying that accumulated savings directly strengthen business resilience (Cumurović & Hyll, 2019; Widagdo & Sa'diyah, 2023). Moreover, maintaining liquidity improves a firm's reputation with suppliers and lenders, enhancing its financial credibility. These findings reaffirm that financial self-reliance through disciplined saving is a key determinant of sustainable MSME growth.

The direct relationship between financial literacy and sustainability is positive but only marginally significant (β = 0.160, t = 1.821, p = 0.069), indicating a weak direct association. Accordingly, throughout the manuscript, we describe financial literacy as having a limited direct effect on sustainability, while its role is more clearly supported through its moderating function on the saving–sustainability relationship (with a negative interaction coefficient), rather than portraying it as a strong direct driver of sustainability.

Although the magnitude is modest, the positive direction is consistent with evidence that financially literate entrepreneurs tend to make better financial and investment decisions and apply more effective financial management practices (Aribawa, 2016; Sulistyowati, Pranoto, and Mas'adah, 2024). Importantly, recent literature emphasizes that financial literacy is a multidimensional capability and does not necessarily translate into firm-level sustainability outcomes unless it is enacted through managerial practices and financial behaviors (Lusardi and Mitchell, 2023; IS, KV, and Hungund, 2025). This perspective helps explain why the direct effect may be weak: MSME owners may possess relatively homogeneous baseline or experiential financial knowledge, which reduces observable variation in "literacy" as a stand-alone predictor, even when formal education differs (Yanto, Kiswanto, et al., 2022). In addition, prior research suggests that the value of financial literacy is often realized through strategic thinking, budgeting precision, and risk anticipation, processes that operate through day-to-day decisions rather than immediately shifting sustainability indicators (Rahmawati, Wahyuningsih, and Garad, 2023). Baporikar and Akino (2020) similarly argue that financial literacy empowers entrepreneurs to minimize errors, improve cash management, and adapt to changing market conditions, reinforcing the idea that literacy primarily operates through behavioral and managerial channels. Consistent with this mechanism, empirical studies on MSMEs show that financial literacy can contribute to sustainability indirectly through financing decisions and risk-management pathways, including how entrepreneurs mobilize internal funds and choose financing strategies (Masdupi, Imran, and Sintya, 2025). Therefore, the marginal direct effect observed in this study is interpreted as evidence that financial literacy is more consequential as an enabling capability that strengthens the conversion of financial resources, such as business savings, into sustainability, rather than as a strong stand-alone driver of sustainability outcomes.

The moderation analysis indicates that financial literacy significantly moderates the relationship between business savings and MSME sustainability, as evidenced by the interaction term (BS×FL) (β = –0.210, t = 7.698, p < 0.001). The negative coefficient indicates that the positive association between business saving and sustainability becomes weaker at higher levels of financial literacy; one plausible mechanism is a capability-substitution effect, whereby financially literate entrepreneurs rely less on accumulated savings alone because they can sustain performance through more effective financial planning, allocation decisions, and broader financing strategies (Cumurović and Hyll, 2019; Risman, 2024). However, this pattern may also reflect alternative explanations, including potential measurement limitations (e.g., business savings capturing the volume rather than the quality/use of savings), suppression effects due to correlated predictors, or model specification issues; therefore, the moderation result is interpreted cautiously and should be further validated in future research.

This pattern is consistent with a capability-substitution mechanism in which higher financial literacy (as a form of human capital) reduces reliance on accumulated savings as the primary pathway to sustain performance, because more financially capable entrepreneurs are better positioned to apply broader financial strategies, such as planning and budgeting discipline, credit management, and diversification of funding sources to maintain sustainability (Cumurović and Hyll, 2019; Risman, 2024). In this sense, business savings remain an important internal buffer. However, its marginal contribution to sustainability may diminish when entrepreneurs can mobilize alternative mechanisms and allocate resources more efficiently, which aligns with evidence that financial capability shapes sustainability through strategic financing and risk-management channels (Masdupi, Imran, and Sintya, 2025).

To facilitate interpretation of the interaction effect, a simple-slopes plot (Figure 1) is presented to illustrate the relationship between business saving and sustainability at low (−1 SD), mean, and high (+1 SD) levels of financial literacy, as recommended for moderation interpretation in PLS-SEM (Fassott, Henseler, and Coelho, 2016; Becker et al., 2015).

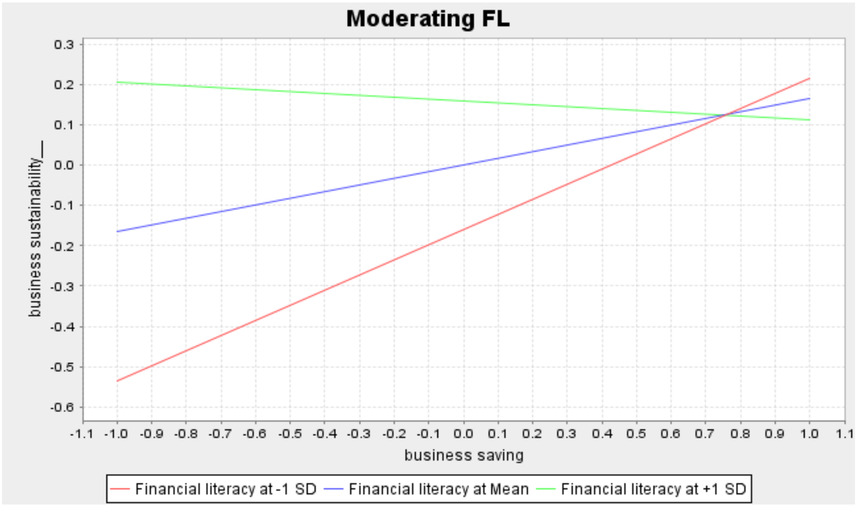

Figure 1. Moderating effect of financial literacy on the relationship between business saving and sustainability of culinary MSMEs (simple slopes at −1 SD, mean, and +1 SD).
Source: Data processed, 2025

Figure 1 shows that the association between saving sustainability and literacy levels varies, consistent with the negative interaction term. Nevertheless, this moderation should be interpreted cautiously, and alternative explanations should be considered. First, the measurement of business saving may capture the volume of saving more strongly than its quality and use (e.g., idle liquidity versus savings deployed for reinvestment and resilience-building), which could yield heterogeneous effects and contribute to a weakening marginal effect at higher literacy levels. Second, the observed interaction may reflect behavioral and contextual heterogeneity, such as differences in access to external finance, demand volatility, or operational constraints across MSME segments, which cannot be fully disentangled in a cross-sectional design. Therefore, while the negative moderation is theoretically plausible, future studies are encouraged to employ richer behavioral measures and longitudinal designs to verify whether the pattern reflects efficiency gains and substitution toward alternative financing channels, or segment-specific differences in how saving is accumulated and utilized (Becker *et al.*, 2015; Fassott, Henseler, and Coelho, 2016).

The mediation analysis confirms that business saving acts as a crucial conduit linking financial inclusion and financial digitalization to the sustainability of culinary MSMEs. Specifically, the indirect effect of financial inclusion through business savings is significant ($\beta = 0.063$, $t = 2.199$, $p = 0.028$), indicating that inclusion strengthens sustainability by enabling entrepreneurs to accumulate internal reserves via improved access to formal financial instruments and safer saving channels. This finding is consistent with evidence that access to formal services supports long-term business viability by enabling better resource allocation, cash management, and capital accumulation (Baporikar and Akino, 2020; Herrera, Warokka, and Aqmar, 2023). Mechanistically, inclusive finance reduces reliance on informal and costly financing, facilitates more stable transaction and account use, and supports routine retention of operating surpluses—thereby increasing the availability of internal funds that can be mobilized when shocks occur or when reinvestment opportunities arise.

In contrast, the indirect pathway from financial digitalization to sustainability through business saving is positive but only marginally significant (β = 0.060, t = 1.781, p = 0.076); therefore, this result is treated as *tentative* rather than conclusive evidence of mediation. Accordingly, the discussion distinguishes this pathway from the significant mediating effect of financial inclusion. It interprets the digitalization–saving–sustainability mechanism as potentially time-lagged and dependent on adoption maturity, which may not be fully captured in current cross-sectional data.

A plausible explanation is that the benefits of digital adoption may be time-lagged: digital tools can improve transaction efficiency, record accuracy, and cash-flow visibility, but these process gains may not immediately translate into sustained surplus accumulation in early stages of adoption (Jirwanto, 2024; Komariyah, 2024). Given the cross-sectional design, the data may capture early operational improvements rather than longer-term resilience outcomes that emerge after usage maturity. From a resource-and-resilience perspective, these mediation results suggest that digitalization and inclusion support sustainability most effectively when they translate into internal financial buffers. Such buffers are central to MSME sustainability because they provide liquidity for day-to-day continuity, reduce vulnerability to demand shocks, and enable gradual reinvestment without immediate dependence on external credit, capabilities repeatedly highlighted as key determinants of SME resilience and long-term viability (Saad *et al.*, 2021; Koporcic *et al.*, 2026). This interpretation also aligns with the sustainable SME finance literature, which emphasizes that financial access contributes to sustainability when it strengthens firms' capacity to mobilize and allocate funds for adaptation, rather than merely increasing the availability of external financing (Hakam and Hakam, 2024). Overall, the findings indicate that business saving is a practical behavioral pathway through which financial inclusion (and, more gradually, digitalization) can be converted into sustainability outcomes in culinary MSMEs, while also implying that digitalization may require sufficient literacy and adoption maturity to generate sustained saving-based resilience (Jirwanto, 2024; Komariyah, 2024).

Finally, total effect analysis reveals that financial literacy exerts the strongest overall influence on sustainability (β_total = 0.826), reflecting its multifaceted role as a direct, indirect, and moderating determinant (Siti Nor Chalimah, Martono, and Khafid, 2019; Hamid *et al.*, 2024). Business saving follows (β_total ≈ 0.196), while financial inclusion exerts a smaller yet significant mediated effect (β_total ≈ 0.040). Interestingly, financial digitalization's total effect is negative (β_total = –0.205), primarily due to the strong negative moderation by literacy. This implies that technology adoption without sufficient literacy may not enhance sustainability and can even produce inefficiencies or mismanagement risks, consistent with Cumurović & Hyll (2019) and recent warnings in digital finance studies (Fitrianti, Fatmawati, and Zaenal, 2023). Therefore, policy initiatives promoting digital finance must be synchronized with literacy enhancement and risk management frameworks to prevent misuse of financial technologies. In conclusion, these findings highlight that MSME sustainability in Central Java is shaped by a balanced interplay between inclusion, digitalization, literacy, and saving discipline. These findings suggest that MSME sustainability may be supported by coordinated initiatives that expand the use of digital financial services, strengthen inclusive access to formal finance, and enhance financial literacy.

After reporting the hypothesis-testing results (Table 3), additional model diagnostics were conducted to evaluate the model's explanatory power critically and to address potential concerns about construct overlap and shared variance that may inflate explanatory metrics in survey-based SEM. This section reports the coefficient of determination (R^2), followed by collinearity diagnostics (inner VIF), as in Tables 4 and 5, and predictive relevance using blindfolding Q^2.

Table 4. R Square

	R Square	R Square Adjusted
business saving	0.371	0.362
business sustainability	0.902	0.900

Source: Data Processed, 2025

The model explains 90.2% of the variance in business sustainability (R^2 = 0.902; adjusted R^2 = 0.900), indicating very high explanatory power; however, this level is unusually high for cross-sectional behavioral survey research and therefore requires cautious interpretation. Specifically, such a high R^2 may reflect (i) construct overlap or conceptual proximity among predictors, (ii) common method variance due to single-source self-reported measurement, and/or (iii) overly similar or highly correlated measurement items across constructs. Although the inner VIF diagnostics suggest that structural multicollinearity is not critical (VIF < 5.0), the upper-range VIF values for sustainability predictors (3.509–3.915) indicate some shared variance that could contribute to the elevated R^2. To triangulate this concern, we also report predictive relevance from blindfolding (Q^2 = 0.599 for business sustainability), which supports the idea that the model retains meaningful predictive relevance beyond its explanatory power. Nevertheless, given the study design, the very high R^2 should be interpreted as potentially influenced by shared measurement context and overlapping construct content, and future research is encouraged to apply additional controls for method bias (e.g., procedural remedies and alternative statistical checks) and out-of-sample prediction, as well as longitudinal or multi-source designs to validate the robustness of the explanatory performance further.

To critically interpret the very high explanatory power for business sustainability, structural collinearity among predictors was assessed using inner VIF, as in Table 5.

Table 5. Inner VIF values

	Business saving	Business sustainability
Financial literacy		3,509
Moderating FL		3,676
Business saving		3,915
Financial digitalization	1,109	
Financial inclusion	1,109	

Source: Data Processed, 2025

The results show minimal collinearity for business savings, with VIF values of 1.109 for both financial digitalization and financial inclusion. For business sustainability, the inner VIF values range from 3.509 to 3.915 (financial literacy = 3.509; moderating FL/interaction term = 3.676; business saving = 3.915). These values remain below the commonly applied threshold of 5.0 for problematic structural collinearity in PLS-SEM, indicating that multicollinearity is not critical.

Predictive relevance was further assessed using the blindfolding procedure. The results indicate acceptable predictive relevance for the endogenous constructs, with Q^2 values of 0.241 for business saving and 0.599 for business sustainability. These values suggest that the model provides meaningful predictive relevance beyond explanatory power, supporting the substantive interpretation of the structural relationships despite the high R^2 reported in Table 4.

The Importance–Performance Map Analysis (IPMA) reveals that financial literacy (FL) is the most influential factor driving MSME sustainability, yet its performance remains moderate (≈60/100). This gap indicates that improving literacy would yield significant sustainability gains. Many MSME owners in Central Java possess limited formal financial knowledge but demonstrate practical experience; however, structured financial education could translate that potential into measurable business outcomes. Based on the IPMA results, financial literacy appears as a high-importance construct with comparatively moderate performance, consistent with the structural model, which shows that literacy plays a key role through its direct and interaction effects rather than as a strong stand-alone predictor. Therefore, the IPMA suggests that improving the performance of financial literacy may yield meaningful gains in sustainability outcomes within the studied sample; however, given the cross-sectional design and purposive sampling, these implications should be interpreted cautiously and framed as indicative priorities for further evaluation rather than definitive policy prescriptions (Rahmawati, Thaha, and Priyanto, 2023; Sulistyowati, Pranoto, and Mas'adah, 2024). Business savings (BS) also shows high importance and performance (≈75/100), confirming that entrepreneurs actively save part of their earnings as a resilience strategy. These findings align with Damayanti *et al.(*2024) and Widagdo & Sa'diyah (2023), who emphasize that consistent saving behavior strengthens financial independence and innovation capacity.

In contrast, financial digitalization (FD) registers only moderate performance (≈52/100) and conditional importance. Its positive impact depends heavily on financial literacy: without adequate financial competence, digital adoption may lead to inefficiencies or misuse (Fitrianti, Fatmawati, and Zaenal, 2023; Komariyah, 2024). Consequently, promoting fintech solutions should always be accompanied by literacy enhancement to achieve "responsible digital inclusion," as highlighted by Rahawarin and Soetjipto.

Financial inclusion (FI) remains the weakest construct in the IPMA (≈46/100), reflecting limited access and underutilization of formal financial services among MSMEs. Although its effect on sustainability is indirect through savings, inclusion forms the foundation for financial stability and long-term growth (Hamid *et al.*, 2024; Tubastuvi and Rusydiana, 2024). Policies should therefore emphasize not only expanding access but also stimulating active use—such as encouraging account retention, micro-savings, and affordable credit channels through digital banking ecosystems (Ratnawati, 2020; Nurkhamid, 2025). Integrating inclusion with literacy and savings programs would help transform access into genuine participation. Overall, the results confirm that the synergy between inclusion, digitalization, saving discipline, and literacy drives MSME sustainability. Digital tools expand opportunities, inclusion ensures financial reach, savings build resilience, and literacy enables effective utilization together forming the pathway toward sustainable and inclusive regional development in Central Java

CONCLUSION

This study addresses the research objectives by examining how financial digitalization, financial inclusion, and financial literacy influence business savings and sustainability among culinary MSMEs in Central Java. The findings indicate that digitalization and financial inclusion significantly enhance business savings, which, in turn, positively contribute to MSME sustainability. Financial literacy does not have a direct effect on sustainability but moderates the relationship between business savings and sustainability, demonstrating that literacy determines how effectively entrepreneurs utilize their financial resources. These results confirm that MSME sustainability is shaped by both access to financial systems and the ability to manage those resources productively.

The novelty of this study lies in its comprehensive analysis of the mediating and moderating mechanisms that connect digitalization, inclusion, and literacy to business sustainability. By identifying business savings as a critical financial bridge, the research provides a deeper understanding of how financial inclusion and digital transformation can translate into long-term business resilience. Furthermore, the moderating effect of financial literacy offers new theoretical insight into how human capital interacts with financial capital, showing that knowledge and capability can substitute for financial reserves in ensuring sustainability. This integrated behavioral-financial model enriches the theoretical discourse on sustainable entrepreneurship within developing economies.

The implications of these findings are substantial for policymakers, business owners, and financial institutions. Governments can design inclusive financial policies that integrate literacy education with digital transformation initiatives. Business owners should be encouraged to adopt savings-oriented management practices and to use digital tools strategically to improve efficiency. Financial institutions, in turn, can develop digital products and services tailored to MSME needs, such as micro-savings accounts, simplified loan applications, and financial advisory platforms to strengthen MSME participation in the formal financial ecosystem.

This study recommends several strategic actions. First, governments should implement continuous financial literacy programs focusing on budgeting, saving, and investment decision-making for MSME owners. Second, regulatory agencies should introduce incentives that encourage formal saving practices, including interest-bearing micro-savings and credit-linked saving schemes. Third, collaboration between banks, fintech firms, and local governments should prioritize digital literacy training to ensure responsible adoption of financial technologies. These efforts will collectively promote resilient, inclusive, and innovative MSMEs that contribute to sustainable regional development.

Future research should investigate the long-term and cross-sectoral effects of financial literacy and digitalization on MSME sustainability. Comparative studies across regions or industries could uncover variations in saving behavior and digital adoption outcomes. Additionally, exploring other mediating factors, such as innovation capability, financial access constraints, and market conditions, would deepen understanding of MSME resilience mechanisms. Examining the longitudinal impacts of digital finance and financial literacy on performance could also reveal how continuous learning and technological adaptation sustain growth. Overall, this study provides a robust empirical foundation for advancing inclusive financial ecosystems that empower MSMEs as engines of sustainable economic development.

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