DIGITAL LEVERAGE FOR MICRO ENTERPRISES: THE MEDIATING ROLE OF INNOVATION IN ENHANCING MSEs PERFORMANCE ACROSS 23 KBLI SECTORS IN INDONESIA

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Abstract

This study investigates the effects of internet utilization, education level, business scale, capital sources, and business constraints on the performance of Micro and Small Enterprises (MSEs) in Indonesia, with innovation positioned as a mediating variable. The analysis draws on secondary data from Statistics Indonesia (BPS) spanning 2020 to 2023, encompassing 23

industrial sectors classified under the KBLI framework. Employing a quantitative explanatory design, the study applies Structural Equation Modeling using the Partial Least Squares (SEM– PLS) approach. The findings reveal that internet usage exerts a positive and statistically significant impact on both innovation and business performance, both directly and indirectly through innovation as a mediator. In contrast, education level, business scale, capital sources, and business constraints do not exhibit significant indirect effects on performance via innovation. The model demonstrates strong explanatory power, as indicated by R-squared values of 0.923 for innovation and 0.932 for business performance. These results underscore the pivotal role of digitalization in fostering innovation-led growth among MSEs. The study highlights the practical importance of enhancing digital infrastructure and promoting technology literacy programs to enable micro and small enterprises to leverage digital opportunities, expand market access, and improve productivity in a sustainable manner.

Keywords: Innovation; digitalization; micro and small enterprise (MSE) performance; SEM-PLS; internet adoption; KBLI classification

INTRODUCTION

The growth of Micro and Small Enterprises (MSEs) in Indonesia serves as a critical pillar of national economic development. According to data from the Ministry of Cooperatives and SMEs, MSEs contribute over 60% to Indonesia's Gross Domestic Product (GDP) and absorb approximately 97% of the national workforce. Despite their significance, most MSEs remain concentrated in specific KBLI sectors, particularly in manufacturing and processing industries, which often face structural challenges in accessing technology, information, and markets (Hutchinson & van Grunsven, 2018; Yahya et al., 2024).

In the context of digital transformation and global competition, innovation has become a key determinant of competitive advantage for MSEs. However, the level of innovation adoption among Indonesian MSEs remains relatively low. This is largely influenced by limited internet usage, low educational attainment among business owners, small business scale, constrained access to capital, and various operational barriers (Gustomo et al., 2019; Masitah et al., 2023). The Indonesian Standard Industrial Classification (KBLI) underscores sectoral disparities in access to innovation-supporting facilities, such as training, technological infrastructure, and financial services. These disparities highlight the importance of a sectoral approach in analyzing the performance dynamics of MSEs.

The central issue lies in understanding how internal and external factors—such as internet usage, owner education level, business scale, funding sources, and business

constraints—influence innovation capacity and enterprise performance. Prior studies have suggested that these factors collectively drive or inhibit productivity and growth potential (Ercole & O'neill, 2017; Widodo et al., 2014). Nevertheless, empirical research that simultaneously examines these interrelationships across multiple KBLI sectors in Indonesia remains scarce—especially studies grounded in a structured conceptual framework. This study therefore aims to analyze the effects of internal factors—including internet usage, education level, business scale, capital sources, and operational constraints—on innovation, and subsequently, on the performance of MSEs across 23 KBLI-classified sectors in Indonesia.

LITERATURE REVIEW

Micro and Small Enterprises (MSEs)

By definition, Micro and Small Enterprises (MSEs) in Indonesia are categorized into two groups: micro-industries, which are manufacturing firms employing 1 to 4 workers; and small industries, which refer to manufacturing firms employing 5 to 19 workers. Beyond their structural classification, MSEs represent the backbone of the Indonesian economy. This sector absorbs over 97% of the national workforce and contributes more than 60% to the country's Gross Domestic Product (GDP) (Coordinating Ministry for Economic Affairs of the Republic of Indonesia, 2025). Despite their substantial contribution, MSEs continue to face multiple constraints, ranging from limited market access to technological gaps. Masitah et al., (2023) highlight the critical role of MSE productivity in maintaining competitiveness amidst digital disruption and global crises, such as the COVID-19 pandemic. Micro-enterprises, in particular, tend to be more vulnerable to economic shocks due to their limited resources.

MSEs Across KBLI-Classified Sectors

The Indonesian Standard Industrial Classification (KBLI) is the official classification system used by Statistics Indonesia (Badan Pusat Statistik/BPS) and other government agencies to categorize economic activities across the country. In the context of Micro and Small Enterprises (MSEs), KBLI serves as a critical framework for conducting structural and sectoral analyses, which inform policy formulation for the development and empowerment of MSEs at both national and regional levels.

According to the 2023 Profile of Micro and Small Industries published by BPS, there are 23 KBLI-classified sectors that are predominantly occupied by MSEs, particularly in manufacturing and resource-based industries. These sectors represent the core of Indonesia's micro and small enterprise landscape.

Table 1. KBLI Sector Classification Relevant to Indonesian MSEs

No	Code KBLI	Sector
1	10	Food Manufacturing
2	11	Beverage Manufacturing
3	12	Tobacco Processing Industry
4	13	Textile Industry
5	14	Apparel Manufacturing
6	15	Leather, Leather Goods, and Footwear Industry
7	16	Wood Industry and Products of Wood and Cork (excluding furniture); Woven Goods from Rattan, Bamboo, and Similar Materials
8	17	Paper and Paper Products Industry
9	18	Printing and Reproduction of Recorded Media
10	20	Chemical and Chemical Products Industry
11	21	Pharmaceutical, Chemical, and Traditional Medicine Products
12	22	Rubber and Plastics Industry
13	23	Non-Metallic Mineral Products Industry
14	24	Basic Metal Industry
15	25	Fabricated Metal Products (excluding machinery and equipment)
16	26	Computer, Electronic, and Optical Products Industry
17	27	Electrical Equipment Industry
18	28	Machinery and Equipment Not Elsewhere Classified (n.e.c.)
19	29	Motor Vehicles, Trailers, and Semi-Trailers Industry
20	30	Other Transportation Equipment Industry
21	31	Furniture Industry
22	32	Other Processing Industries
23	33	Repair and Installation of Machinery and Equipment Services

Each KBLI-classified sector exhibits distinct input–output characteristics. For instance, the food sector (KBLI 10) heavily relies on agricultural supply chains and local raw materials, whereas the metal sector (KBLI 25) depends on industrial infrastructure and heavy equipment. A study by Ercole & O'neill (2017), highlights that both business location and sector type (as defined by KBLI) significantly influence economic agglomeration, productivity, and the competitiveness of Micro and Small Enterprises (MSEs). Therefore, a sectoral approach grounded in the KBLI classification is essential to capture the diversity of challenges and opportunities faced by MSEs across different industries.

Internet Utilization in the Transformation of Micro and Small Enterprises (MSEs)

The internet serves as a fundamental pillar of digitalization, driving the transformation of Micro and Small Enterprises (MSEs) in Indonesia. Its usage spans a wide range of business functions, including promotion, marketing, access to fintech loans, and information retrieval—each contributing to improved production efficiency, market expansion, and innovation capability. A study by Fizzanty & Maulana (2024) reveals that MSEs that rapidly adopt digital technologies demonstrate stronger business resilience, particularly in the post-pandemic period. Nevertheless, significant digital disparities remain between urban and rural areas, largely due to limitations in infrastructure, digital literacy, and the high cost of internet access. These disparities further widen regional productivity gaps. Reports by the OECD (2021) and the G20 SME Ministerial (2022) einforce these findings, emphasizing the critical role of digitalization as a strategy for sustainable growth and competitiveness of MSEs in the Industry 4.0 era.

Educational Attainment of Business Owners in the Dynamics of

Micro and Small Enterprises (MSEs)

The education level of business owners significantly influences decision-making, digital readiness, and adaptive capacity in managing MSEs. Higher levels of education enhance entrepreneurs' ability to access technology, obtain financing, and build collaborative networks—factors that are vital for navigating competitive and dynamic business environments (Kadiyono & Susanto, 2025). Innovation is also more likely to emerge among better-educated MSEs owners, positioning education as a mediating factor in improving business performance. Tambunan (2022) argues that MSEs actors with lower educational backgrounds tend to focus on routine operations, often neglecting financial documentation and innovation activities. Educational disparities contribute to widening competitiveness gaps between urban and rural enterprises. Therefore, managerial training and improved business literacy are critical strategies in strengthening the human capital capacity of MSEs and promoting inclusive enterprise development.

Business Scale and the Adaptive Capacity of Micro and Small Enterprises (MSEs)

Business scale plays a pivotal role in shaping production capacity, operational efficiency, and the resilience of MSEs to external shocks. Larger-scale MSEs typically possess more defined managerial structures, greater access to technology, and increased flexibility in resource allocation—enabling them to be more adaptive to market changes and more prepared to pursue innovation (Márquez-Ramos, 2022). Conversely, micro-enterprises often

face constraints in capital, labor, and access to training, making them more vulnerable to external disruptions. Larger business scale also facilitates efficiency gains through economies of scale and eases market expansion. Therefore, business scale should not be viewed merely as a measure of output, but as a strategic indicator of long-term sustainability and adaptive capacity.

Sources of Capital and Financing Constraints Among Micro and Small Enterprises (MSEs)

Access to capital is a critical determinant of MSE growth, influencing investment capacity, technology adoption, and financial resilience. However, the majority of MSEs in Indonesia still rely heavily on personal savings or informal loans, which significantly limit their ability to scale and compete in the broader market (Halimanjaya, 2017). Public financing instruments such as climate funds and investment subsidies have yet to effectively reach the MSE sector, particularly those embedded in community-based enterprises. This challenge is exacerbated by low levels of financial literacy and the lack of formal documentation among many MSEs. Sahara et al., (2022) further note that technical and bureaucratic barriers, combined with top-down program designs, have hindered the optimal and context-sensitive distribution of capital support—especially when assessed against the structural diversity of KBLI sectors. An effective solution lies in the development of inclusive financing schemes tailored to sectoral needs, involving collaboration among financial institutions, local governments, and MSE associations. The integration of digitalized processes is also essential to enhance accessibility, transparency, and accountability in financing mechanisms.

Operational Barriers Facing Micro and Small Enterprises (MSEs)

MSEs in Indonesia encounter a range of operational constraints, including limited access to raw materials, complex licensing procedures, price volatility, restricted distribution networks, and dependency on local markets. These barriers undermine business stability and constrain enterprise development capacity. According to Widodo et al., (2014), such barriers are spatially driven and strongly influenced by location and logistics infrastructure. Labor-intensive sectors under the KBLI classification—such as textiles and metal industries—are particularly vulnerable to supply chain disruptions and trade regulations. These challenges hinder the ability of MSEs to innovate and adapt to market dynamics, thereby negatively affecting productivity and overall performance. Business constraints are not merely administrative but represent structural impediments to the creation of an enabling innovation ecosystem. Thus, targeted interventions are required, including regulatory simplification, subsidized access to raw materials, and

improved logistical connectivity to support innovation and promote long-term sustainability within the MSE sector.

Innovation as a Strategic Element in Enhancing MSE Performance

Innovation serves as a strategic factor that mediates the influence of both internal and external resources on the performance of Micro and Small Enterprises (MSEs). It encompasses not only product development but also improvements in processes, distribution channels, and management practices. In a dynamic business ecosystem, innovation is a key differentiator between enterprises that evolve and those that remain stagnant. According to Kadiyono & Susanto (2025), innovation emerges from the interaction of education, technology (particularly internet usage), and external support systems such as incubators and strategic partnerships. Innovation also plays a mediating role between educational attainment and enterprise performance. Unfortunately, many MSEs actors still perceive innovation as a supplementary activity rather than a core business function, primarily due to operational pressures and resource constraints. This study explicitly positions innovation as a mediating variable linking internet adoption, education level, business scale, capital sources, and operational constraints to MSEs performance. Such an approach offers a comprehensive understanding of innovation-driven performance mechanisms across diverse KBLI-classified sectors.

MSE Performance as the Ultimate Indicator of Business Success

The performance of Micro and Small Enterprises (MSEs) reflects both operational and strategic success, commonly measured through indicators such as revenue, expenditure, and profit. These metrics capture the entrepreneur's capacity to manage resources effectively and respond to market dynamics. According to Masitah et al., (2023), MSEs that embrace innovation and adopt digital technologies tend to exhibit superior performance—even under external pressures such as the COVID-19 pandemic. MSE performance is shaped by a combination of internal factors (e.g., capital, education, innovation, business scale) and external factors (e.g., market access, policy environment, macroeconomic conditions). Innovation and digitalization play a pivotal role in improving efficiency, adding value, and expanding market reach. Therefore, MSEs performance should not be assessed solely through financial indicators, but also through strategic outcomes and long-term business resilience.

METHODOLOGY

This study employs a quantitative approach with an explanatory research design, aimed at examining the causal relationships between multiple independent variables and the performance of Micro and Small Enterprises (MSEs), with innovation serving as the primary mediating variable. This approach is appropriate within the socio-economic research context, particularly when exploring how factors such as education, internet access, business scale, sources of capital, and business constraints influence the performance through innovation as an intervening mechanism (Hair et al., 2020). The conceptual model was developed based on a theoretically grounded framework and is illustrated in the Figure 1.

The study utilizes secondary data obtained from official publications of Statistics Indonesia (Badan Pusat Statistik/BPS), specifically the Micro and Small Industry Statistics from 2020 to 2023. These datasets also include sectoral-level information aligned with the Indonesian Standard Industrial Classification (KBLI) structure relevant to MSEs. Data for 2024 were not included, as official publications had not yet been released at the time of the study. The dataset covers key characteristics of MSEs actors across 23 KBLI-classified sectors in Indonesia, as detailed in the Table 2 below.

Table 2. Variables and Indicators

Variable	Indicator
Internet Use	For promotion/advertising
	For product marketing/sales
	For raw material procurement
	For accessing fintech/loans
	For information searching
Educational Level	No formal schooling or did not complete elementary school
	Elementary school
	Junior high school
	Senior high school
	Vocational high school
	Diploma I/II/III
	Diploma IV/Bachelor's degree or higher
Business Scale	Within the same regency/city
	Outside the regency/city but within the same province
	Inter-provincial
	International/export-oriented

Variable	Indicator
Source of Capital	Entirely self-funded
	Bank loans
	Cooperatives
	Non-bank financial institutions
	Individuals or family
	Government loan programs
	Private institutional loans
Business Difficulties	Difficulty in obtaining raw materials
	Financial/capital constraints
	Marketing-related challenges
	Fuel/energy shortages
	Infrastructure limitations
	Labor shortage
	Weather-related disruptions
	Other external/internal constraints
Innovation	Product innovation
	Marketing/distribution innovation
	Technological/process innovation
	Other forms of innovation
Performance	revenue
	expenditure
	profit

Data analysis was conducted using Structural Equation Modeling based on Partial Least Squares (SEM–PLS), implemented through the latest version of SmartPLS software (SmartPLS ver 4.1.1.2). SEM–PLS was selected due to its advantages in estimating complex theoretical models involving multiple latent constructs, as well as its robustness in handling non-normally distributed data (Sarstedt et al., 2022). The analysis proceeded in two main stages:

1. Measurement model assessment (outer model), which evaluates the reliability and validity of the constructs and indicators, and
2. Structural model assessment (inner model), which examines the significance of hypothesized relationships among latent variables and assesses the mediating effect of innovation on business performance.
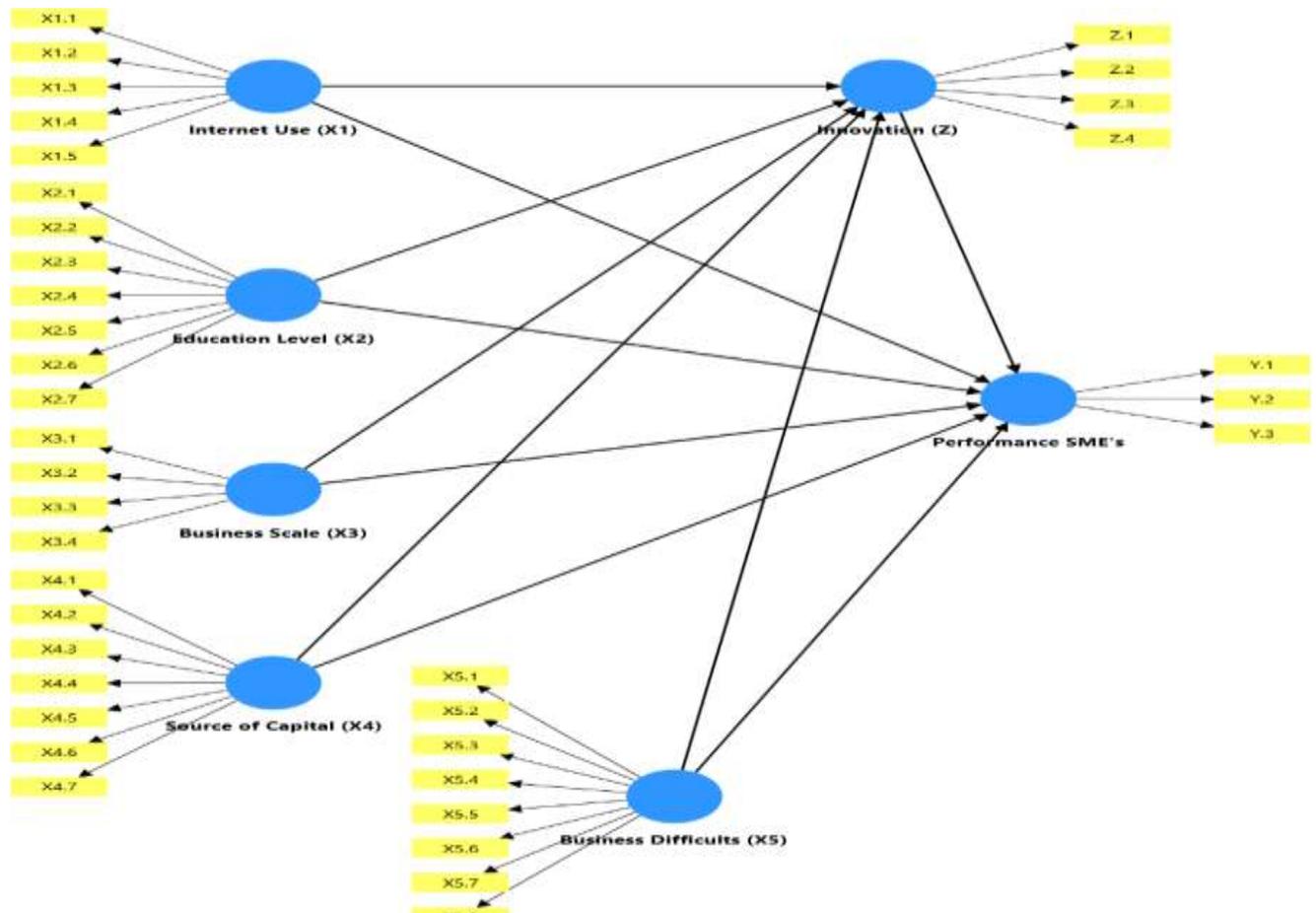
Figure 1. Conceptual Framework

Based on the conceptual framework presented in Figure 1, the following hypotheses are proposed for empirical testing:

H_1 Internet usage has a significant effect on the performance of Micro and Small Enterprises (MSEs) in Indonesia.

H_2 The education level of MSE owners has a significant effect on MSE performance in Indonesia.

H_3 Business scale has a significant effect on the performance of MSEs in Indonesia.

H_4 Sources of capital have a significant effect on the performance of MSEs in Indonesia.

H_5 Business constraints have a significant effect on the performance of MSEs in Indonesia.

H_6 Innovation has a significant effect on the performance of MSEs in Indonesia.

H_7 Internet usage has a significant effect on MSE performance mediated by innovation.

H_8 Education level of MSE owners has a significant effect on MSE performance mediated by innovation.

H_9 Business scale has a significant effect on MSE performance mediated by innovation.

H_{10} Sources of capital have a significant effect on MSE performance mediated by innovation.

H_{11} Business constraints have a significant effect on MSE performance mediated by innovation.

RESULT & DISCUSSION

The results and discussion of this study are divided into two main analytical categories: the outer model and the inner model. The first category—outer model analysis—is presented and discussed in detail through the following sub-sections.

Outer model

The first criterion in the outer model assessment involves analyzing the outer loadings of each item or indicator. Outer loadings, also referred to as loading factors (LF), represent the correlation between each measurement item and its respective latent construct. They are essential in evaluating how well an indicator reflects the construct being measured (Yamin, 2023). Following the threshold recommended by Hair et al., (2021), an outer loading value is considered acceptable if it is ≥ 0.70. Indicators with loadings below this threshold may be subject to further evaluation or removal, depending on their theoretical relevance and contribution to construct validity.

Table 3. Loading Factor

	Internet Use (X_1)	Education Level (X_2)	Business Scale (X_3)	Source of Capital (X_4)	Business Constraints (X_5)	Innovation (Z)	Performance MSEs
X1.1	0.985						
X1.2	0.981						
X1.3	0.978						
X1.4	0.891						
X1.5	0.980						
X2.1		0.910					
X2.2		0.944					
X2.3		0.978					
X2.4		0.988					
X2.5		0.921					
X2.6		0.895					
X2.7		0.946					

	Internet Use (X₁)	Education Level (X₂)	Business Scale (X₃)	Source of Capital (X₄)	Business Constraints (X₅)	Innovation (Z)	Performance MSEs
X3.1			0.923				
X3.2			0.967				
X3.3			0.891				
X3.4			0.725				
X4.1				0.976			
X4.2				0.918			
X4.3				0.854			
X4.4				0.920			
X4.5				0.849			
X4.6				0.835			
X4.7				0.922			
X5.1					0.973		
X5.2					0.988		
X5.3					0.961		
X5.4					0.929		
X5.5					0.937		
X5.6					0.948		
X5.7					0.923		
X5.8					0.940		
Z.1						0.965	
Z.2						0.953	
Z.3						0.927	
Z.4						0.897	
Y.1							1
Y.2							0.997
Y.3							0.996

Outer loadings (LF) serve as a critical indicator in assessing the convergent validity of latent constructs within a reflective measurement model. Based on the results presented in the table above, it can be concluded that the majority of indicators demonstrate loading values above the 0.70 threshold—indicating that each item contributes significantly to the reflection of its respective construct (Hair et al., 2021). The next criteria in the outer model evaluation involve assessing convergent validity using Cronbach's alpha, Composite Reliability (CR), and Average Variance Extracted (AVE). These indicators collectively verify the internal consistency and

average explanatory power of each latent variable. The results of these tests are summarized in the following table.

Table 4. Convergent Validity

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Business Constraints (X5)	0.985	0.986	0.987	0.903
Business Scale (X3)	0.903	0.941	0.932	0.777
Education Level (X2)	0.978	0.979	0.982	0.885
Innovation (Z)	0.952	0.954	0.966	0.876
Internet Use (X1)	0.980	0.984	0.985	0.928
Performance MSEs	0.998	0.998	0.998	0.995
Source of Capital (X4)	0.959	0.962	0.967	0.805

The table above presents the results of convergent validity assessment, beginning with Cronbach's alpha. Cronbach's alpha is used to evaluate the internal consistency of each construct, with a commonly accepted threshold of ≥ 0.70 (Hair et al., 2021). In addition to Cronbach's alpha, Composite Reliability (CR) is also employed to assess construct reliability.. According to Henseler et al., (2009), a minimum CR value of 0.70 is required, although Hair et al., (2019), suggest that in exploratory studies, values between 0.60 and 0.70 may still be considered acceptable. The results indicate that all latent constructs in this study exhibit Cronbach's alpha values ≥ 0.90 and CR values ≥ 0.94—clearly demonstrating very strong internal reliability across all measurement constructs.

Convergent validity was further assessed using Average Variance Extracted (AVE), which represents the average amount of variance captured by a construct relative to the variance attributable to measurement error. According to Yamin (2023), AVE reflects the extent to which a latent variable, as a whole, is able to explain the variance in its associated indicators. Menurut Hair et al., (2021), recommend a minimum threshold of 0.50 for AVE to confirm convergent validity. As shown in the table above, all AVE values exceeded 0.70, with some constructs approaching 1.00—for instance, Performance of MSEs (AVE = 0.995) and Internet Use (AVE = 0.928). High AVE values indicate that over 70% of the variance in the indicators is explained by the latent constructs, thus meeting the criterion for convergent validity (Fornell & Larcker, 1981). Overall, no constructs in the model failed to meet the AVE requirement,

confirming that all latent variables demonstrate satisfactory convergent validity and are suitable for further structural model evaluation.

Inner Model

The first criterion in the evaluation of the inner model involves analyzing the path coefficients to test the hypothesized direct effects among latent constructs. This analysis follows a two-tailed test approach, where a path is considered statistically significant if the t-statistic exceeds 1.65 (at the 10% significance level) and the p-value is below 0.10. This threshold is adopted due to the exploratory nature of the study and the limitations of the dataset. The use of a more relaxed significance threshold (10%) is methodologically appropriate in exploratory studies aiming to uncover early-stage or context-specific relationships (Hair et al., 2021). The results of the path coefficient analysis, based on the specified criteria, are presented in the following table.

Table 5. Path Coefficient

Path Coefficient	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Business Constraints (X_5) -> Innovation (Z)	-0.143	-0.141	0.163	0.878	0.380
Business Constraints (X_5) -> Performance MSEs	0.366	0.364	0.182	2.011	0.044
Business Scale (X_3) -> Innovation (Z)	0.085	0.080	0.083	1.032	0.302
Business Scale (X_3) -> Performance MSEs	0.221	0.221	0.065	3.410	0.001
Education Level (X_2) -> Innovation (Z)	0.066	0.055	0.228	0.289	0.773
Education Level (X_2) -> Performance MSEs	-0.323	-0.344	0.210	1.541	0.123
Innovation (Z) -> Performance MSEs	-0.184	-0.183	0.106	1.739	0.082
Internet Use (X_1) -> Innovation (Z)	0.921	0.920	0.105	8.766	0.000
Internet Use (X_1) -> Performance MSEs	0.641	0.654	0.157	4.086	0.000
Source of Capital (X_4) -> Innovation (Z)	0.034	0.049	0.159	0.211	0.833
Source of Capital (X_4) -> Performance MSEs	0.266	0.274	0.160	1.661	0.097

Based on the path coefficient analysis using the SEM–PLS approach, internet usage (X_1) was found to have a statistically significant effect on both innovation (Z) and the performance of Micro and Small Enterprises (MSEs) (Y). The relationship between $X_1 \rightarrow Z$ yielded a path coefficient of 0.921, with a t-statistic of 8.766 and a p-value of 0.000—indicating a very strong and highly significant relationship. This finding highlights the catalytic role of

digitalization in the transformation of micro and small enterprises, particularly in stimulating innovative activities. The strength of this relationship is further reinforced by high outer loading values for key indicators, such as internet usage for promotion/advertising (X1.1 = 0.985) and product marketing/sales (X1.2 = 0.981), which represent the backbone of digital marketing strategies among MSEs. Theoretically, these findings align with prior studies such as those by the OECD (2021) and G20 SME Ministerial (2022), which emphasize that active participation in digital ecosystems accelerates the adoption of technology-based innovations and improves production process efficiency.

In addition, internet usage was also found to have a direct and statistically significant effect on MSE performance, with a path coefficient of 0.641 (t = 4.086; p = 0.000). Indicators such as online procurement of raw materials (X1.3 = 0.978) and digital information search for business-related purposes (X1.5 = 0.980) contribute substantially to enhancing market responsiveness and decision-making agility. These findings underscore that digitalization is not merely a supplementary tool but a core strategic driver for maintaining business performance—particularly in the post-pandemic recovery phase.

On the other hand, business scale (X_3) was found to have a positive and statistically significant effect on MSE performance (β = 0.221; t = 3.410; p = 0.001). This finding suggests that broader market reach—from local to interprovincial or even export-oriented operations—is associated with greater adaptive capacity and operational efficiency. Key indicators such as inter-regional operations within the same regency/city (X3.1 = 0.923) and operations beyond regional boundaries (X3.2 = 0.967) reinforce the argument that market expansion offers strategic advantages in terms of risk diversification and revenue growth. This is consistent with the findings of Márquez-Ramos (2022), who emphasized that business scale is a key predictor of firm resilience amidst economic fluctuations.

A positive relationship was also found between business constraints (X_5) and MSEs performance (β = 0.366; t = 2.011; p = 0.044), revealing a paradoxical dynamic in which external barriers—such as limitations in raw materials, marketing, or infrastructure—do not necessarily lead to negative outcomes. Instead, such challenges may stimulate adaptive responses among entrepreneurs. High-loading indicators such as capital difficulties (X5.2 = 0.988) and marketing-related constraints (X5.3 = 0.961) indicate that MSEs capable of strategically managing these challenges can, in fact, enhance their competitive advantage. This phenomenon aligns with the concept of "resilience-driven performance" in the literature, where external pressures act as indirect triggers for innovation and performance improvement (Widodo et al., 2014).

Sources of capital (X_4) also exhibited a statistically significant relationship with MSEs performance (β = 0.266; t = 1.661; p = 0.097). Although the result is considered marginally significant, it suggests that diversified access to financing—from personal funds (X4.1 = 0.976) to private institutional loans (X4.7 = 0.922)—can enhance the operational capacity of micro and small enterprises. This finding reinforces the argument made by Sahara et al., (2022) who noted that financial inclusion strategies tailored to local characteristics can substantially improve efficiency and scale of production among MSEs.

However, some relationships in the model were found to be statistically non-significant. Education level (X_2) did not exhibit a meaningful effect on either innovation (β = 0.066; p = 0.773) or MSE performance (β = −0.323; p = 0.123). Despite high outer loadings for specific indicators such as senior high school graduates (X2.4 = 0.988) and diploma IV/bachelor's degree or higher (X2.7 = 0.946), these educational qualifications may not directly translate into measurable business outcomes. This result may be attributed to a mismatch between formal education and the practical skillsets required for operating micro-enterprises. Supporting this interpretation, Tambunan (2022) observed that even well-educated MSEs owners often remain in small-scale operations due to limited access to markets and financing.

Interestingly, the innovation variable (Z), which was designed as a mediating construct in the model, exhibited a weak and negative effect on MSE performance (β = −0.184; p = 0.082). Although measurement indicators such as product innovation (Z1 = 0.965) and production process innovation (Z3 = 0.927) demonstrate strong convergent validity, the empirical results suggest that innovation has not yet been effectively integrated into the core operational strategies of MSEs. This implies that innovation activities in Indonesia's MSEs sector remain largely reactive rather than proactive. In other words, innovation tends to occur as a response to external pressures rather than as a planned and systematic strategy for competitive advantage. Kadiyono & Susanto (2025) argue that innovation becomes effective only when supported by a robust managerial system, adequate technological literacy, and sufficient external incentives. The absence of these foundational elements may explain the limited impact of innovation on performance within the observed sample.

Ultimately, the variables Business Constraints (X_5), Business Scale (X_3), Source of Capital (X_4), and Education Level (X_2) were found to have no statistically significant relationship with innovation (Z). This indicates that innovation within Indonesia's MSEs sector is not yet shaped by structural conditions or internal resource factors, but is more strongly influenced by technological and digital enablers—specifically internet usage. These findings suggest that innovation in the MSEs context remains primarily technology-driven rather than resource-driven. As a result, policy interventions aimed at strengthening innovation should not be limited to

improving education or access to capital alone, but must also prioritize digital literacy enhancement and inclusive adoption of online platforms.

Tabel 6. Mediating Test (Specific Indirect Effect)

Specific Indirect Effect	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Business Constraints (X_5) -> Innovation (Z) -> Performance MSEs	0.026	0.031	0.042	0.625	0.532
Business Scale (X_3) -> Innovation (Z) -> Performance SME's	-0.016	-0.012	0.017	0.931	0.352
Education Level (X_2) -> Innovation (Z) -> Performance MSEs	-0.012	-0.016	0.049	0.245	0.806
Internet Use (X_1) -> Innovation (Z) -> Performance MSEs	-0.169	-0.169	0.101	1.674	0.094
Source of Capital (X_4) -> Innovation (Z) -> Performance MSEs	-0.006	-0.011	0.035	0.177	0.860

Subsequently, a mediation analysis was conducted to evaluate whether the innovation variable (Z) serves as an intervening construct that mediates the relationship between five exogenous variables—Internet Use (X_1), Education Level (X_2), Business Scale (X_3), Source of Capital (X_4), and Business Constraints (X_5)—and the Performance of MSEs (Y). The criteria for statistical significance followed Hair et al. (2021), whereby a mediating effect is considered significant when the t-statistic exceeds 1.65 and the p-value is below 0.10, reflecting the minimum acceptable threshold for significance in policy-oriented social research.

The mediation test results revealed that only one indirect relationship was statistically significant: Internet Use (X_1) → Innovation (Z) → Performance of MSEs (Y), with a t-statistic of 1.674 and a p-value of 0.094. This indicates that internet usage indirectly enhances business performance through the improvement of innovation activities. Conceptually, this pathway is supported by the strong contribution of digital utilization indicators such as online promotion/advertising (X1.1 = 0.985), sales (X1.2 = 0.981), and information search (X1.5 = 0.980), which stimulate innovation behaviors including product innovation (Z1 = 0.965) and technological/process innovation (Z3 = 0.927). This finding is consistent with Fizzanty & Maulana (2024), who emphasized that digitalization broadens innovation opportunities in the informal sector, thereby indirectly improving competitiveness and performance among micro and small enterprises.

Meanwhile, the mediating effect of Innovation (Z) in the relationship between Business Constraints (X5) and MSE performance was found to be statistically non-significant (t = 0.625; p = 0.532). Although key indicators such as capital difficulties (X5.2 = 0.988) and marketing challenges (X5.3 = 0.961) demonstrated high outer loadings, the results suggest that operational pressures have not yet been effectively translated into innovation as an adaptive response. In other words, MSEs actors tend to focus on resolving short-term obstacles without leveraging them as opportunities for strategic innovation. This reinforces the notion that innovation is not yet embedded as a deliberate crisis-response mechanism within the strategic behavior of MSEs. As noted by Widodo et al., (2014), innovation in the MSE sector often fails to emerge from structural adversity unless supported by a broader ecosystem that encourages adaptive and forward-looking strategies.

Similarly, the mediating effect of Innovation (Z) in the relationship between Business Scale (X_3) and MSEs performance was not statistically supported (t = 0.931; p = 0.352). This result is somewhat unexpected given the strong indicator loadings for inter-provincial market reach (X3.2 = 0.967) and inter-regency/city operations (X3.1 = 0.923). The limited mediating role of innovation suggests that business scale primarily affects performance through direct pathways—such as operational efficiency and distribution expansion—rather than through innovation-driven mechanisms. In other words, scaling up operations appears to yield more immediate outcomes in logistical and financial efficiency than in fostering exploratory product or process innovation.

The mediating effect of Innovation (Z) in the relationship between Education Level (X_2) and MSE performance was also found to be statistically non-significant (t = 0.245; p = 0.806), despite the strong indicator validity for formal education levels such as senior high school (X2.4 = 0.988) and diploma IV/bachelor's degree or higher (X2.7 = 0.946). This finding implies a disconnect between formal education and practical innovation capability among MSEs actors. In other words, academic qualifications alone may not sufficiently equip entrepreneurs with the skills needed to drive innovation within their enterprises. Tambunan (2022) emphasizes that entrepreneurship training and technological literacy tend to have a more substantial impact on innovation in the MSEs sector compared to formal academic background. This highlights the need for more applied, skill-oriented interventions to foster innovation readiness among micro and small entrepreneurs.

Likewise, the mediating role of Innovation (Z) in the relationship between Source of Capital (X_4) and MSEs performance was not statistically significant (t = 0.177; p = 0.860). Although indicators such as self-funding (X4.1 = 0.976) and bank financing (X4.2 = 0.918) demonstrated strong measurement reliability, the insignificance of the mediating path suggests

that available capital is primarily allocated to basic operational needs rather than to innovation-related investments. Taken together, these findings indicate that only internet use significantly stimulates innovation as a mediator in improving MSEs performance. This supports the argument that innovation processes in Indonesia's MSEs sector remain highly dependent on digital access and technological infrastructure, rather than on traditional resources such as education or capital. These results underscore the urgency of inclusive, digitally driven policy interventions—particularly for labor-intensive KBLI-classified sectors— to ensure that micro and small enterprises are not left behind in the broader innovation ecosystem.

Table 7. R-square

	R-square	R-square adjusted
Innovation (Z)	0.923	0.918
Performance SME's	0.932	0.927

The R-Square (R^2) value represents the coefficient of determination, indicating the proportion of variance in an endogenous (dependent) variable that can be explained by the exogenous (independent) variables within the SEM–PLS model. A higher R^2 value reflects stronger explanatory power, signifying that the model more effectively accounts for the variance observed in the latent construct (Hair et al., 2021).

The Innovation variable (Z) yielded an R-Square (R^2) value of 0.923, indicating that 92.3% of the variance in innovation can be explained by the five main independent variables: Internet Use (X1), Education Level (X2), Business Scale (X3), Source of Capital (X4), and Business Constraints (X5). This value falls under the "very substantial" category as defined by Chin (1998) and Falk & Miller (1992), who consider R^2 values ≥ 0.67 to indicate strong explanatory power. This finding suggests that the model provides an excellent fit in explaining the latent construct of innovation among MSEs in Indonesia. It is further supported by the high reliability of innovation indicators—such as product innovation (Z1 = 0.965) and marketing innovation (Z2 = 0.953)—demonstrating strong internal consistency. The high R^2 value is also aligned with the strong direct effect of Internet Use on Innovation (β = 0.921; $p < 0.001$), emphasizing that digital engagement is a primary driver in shaping the innovation capacity of micro and small enterprises in Indonesia.

For the Performance of MSEs (Y), the model yielded an R-Square (R^2) value of 0.932, indicating that 93.2% of the variance in performance can be explained by the five exogenous constructs (X1–X5) and the mediating variable Innovation (Z). This result reflects a very strong explanatory capacity, suggesting that the model effectively captures nearly all the variation

influencing the performance of micro and small enterprises across 23 KBLI-classified sectors in Indonesia. The strength of this construct is further validated by highly reliable indicators such as revenue (Y1 = 1.000) and profit (Y3 = 0.996), which contribute significantly to the latent variable structure. Among the predictors, the most substantial direct effects were observed from Internet Use on Performance (β = 0.641; p < 0.001) and Business Constraints on Performance MSEs (β = 0.366; p = 0.044), underscoring the relevance of both external and internal factors in shaping business success. This high R^2 value lends strong empirical support for policies focused on digital transformation, the reduction of operational barriers, and the optimization of capital and business scale as effective strategies to enhance performance within the Indonesian MSE sector—particularly across the 23 KBLI sectors under analysis.

CONCLUSION

This study investigates the influence of internet usage, education level, business scale, sources of capital, and business constraints on the performance of Micro and Small Enterprises (MSEs) in Indonesia, with innovation positioned as a mediating variable. The analysis utilizes secondary data from Statistics Indonesia (BPS) for the period 2020–2023 and applies a quantitative approach using Structural Equation Modeling–Partial Least Squares (SEM–PLS). The results reveal that internet usage (X_1) has a statistically significant direct effect on both innovation (Z) and MSE performance (Y). Key indicators such as internet use for promotion/advertising (X1.1), marketing (X1.2), and raw material procurement (X1.3) exhibit high loading factors, highlighting the critical role of digitalization in accelerating business processes. Furthermore, internet usage is the only variable that demonstrates a statistically significant indirect effect on performance through innovation (*p*-value = 0.094), reinforcing the notion that internet adoption acts as a catalyst for innovation and performance enhancement within the MSEs sector in the digital era.

In contrast, education level (X_2), business scale (X_3), sources of capital (X_4), and business constraints (X_5) did not exhibit statistically significant indirect effects on performance through innovation. This finding suggests that although these dimensions are theoretically relevant, their contributions to innovation are not yet robust enough to generate significant performance improvements via mediating mechanisms. Specifically, education demonstrated a positive but non-significant correlation with innovation, indicating that formal educational attainment alone may be insufficient to enhance innovative capacity within MSEs. This underscores the importance of complementary interventions—such as entrepreneurship training, digital literacy, and institutional partnerships—to translate human capital into tangible innovation outcomes that drive enterprise performance.

The coefficient of determination (R²) in this model demonstrates a very strong explanatory power, with values of 0.923 for the innovation construct and 0.932 for MSEs performance. These results indicate that over 90% of the variance in both endogenous variables can be explained by the set of exogenous variables included in the model. Such high R² values reflect the robustness and reliability of the construct measurements, as well as the appropriateness of the model specification. The coefficient of determination (R²) in this model demonstrates a very strong explanatory power, with values of 0.923 for the innovation construct and 0.932 for MSEs performance. These results indicate that over 90% of the variance in both endogenous variables can be explained by the set of exogenous variables included in the model. Such high R² values reflect the robustness and reliability of the construct measurements, as well as the appropriateness of the model specification.

Digital transformation initiatives must be reinforced through affirmative policies and equitable infrastructure development to ensure internet adoption reaches all micro and small enterprises (MSEs), particularly those in rural areas. The practical implications of this finding suggest that innovation enhancement programs should be directly linked to digital support mechanisms, rather than relying solely on capital provision or formal education. In this context, internet accessibility emerges not only as a technological enabler but also as a structural prerequisite for inclusive innovation. Moreover, this study provides a foundation for developing hybrid models that integrate digital literacy, strategic partnerships, and sector-based empowerment—especially tailored to labor-intensive sectors categorized under the Indonesian Standard Industrial Classification (KBLI). Future policy frameworks should therefore prioritize a multidimensional approach, addressing technological, institutional, and human capital dimensions simultaneously to foster sustainable competitiveness among MSEs.

Future studies should consider incorporating longitudinal data to capture the temporal dynamics of innovation adoption and performance outcomes among MSEs. Additionally, qualitative or mixed-methods approaches may provide deeper insights into the behavioral, managerial, and institutional factors that influence innovation practices. Expanding the model to include environmental, policy, and cultural variables could also enhance its explanatory power. Finally, further research could explore comparative analyses across regions or countries to examine how differing levels of digital infrastructure and policy ecosystems affect the innovation–performance nexus in micro and small enterprise development.

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