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The Mediating Role of Digital Literacy in the Relationships Between Digital Payment and Marketplace Adoption, MSME Sustainability, and Competitiveness in Makassar City

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Abstract

Purpose: This study examines the relationships of digital payment adoption and marketplace use with MSME sustainability and competitiveness in Makassar City, Indonesia, focusing on the mediating role of digital literacy.

Methodology: A quantitative survey was conducted involving 300 MSMEs selected through purposive sampling. Data were collected using structured questionnaires and analyzed using partial least squares structural equation modeling (PLS-SEM) with SmartPLS 4.

Findings: The results indicate that digital payment adoption positively and significantly affects MSME competitiveness ($\beta = 0.401$, $p < .001$), while marketplace use positively affects sustainability ($\beta = 0.367$, $p < .001$). However, the direct effects of digital payment adoption on sustainability ($\beta = 0.070$, $p = .213$) and marketplace use on competitiveness ($\beta = -0.043$, $p = .540$) are not statistically significant. Digital literacy has significant positive relationships with both sustainability ($\beta = 0.374$, $p < .001$) and competitiveness ($\beta = 0.500$, $p < .001$). Furthermore, all four indirect effects through digital literacy are statistically significant, with coefficients ranging from 0.160 to 0.258 ($p < .001$).

Practical Implications: The findings suggest that MSME development initiatives should complement digital technology adoption with digital literacy development, particularly in transaction data analysis, digital marketing, and customer relationship management.

Originality: This study examines digital literacy as a mediating mechanism linking digital payment adoption and marketplace use with two distinct MSME outcomes: sustainability and competitiveness. The findings highlight the importance of considering digital capabilities alongside technology adoption when examining MSME performance.

Keywords: Digital Payment Adoption; Marketplace Use; Digital Literacy; MSME Sustainability; MSME Competitiveness.

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1) Introduction

Digital transformation has become increasingly important for micro, small, and medium-sized enterprises (MSMEs), offering opportunities to improve transaction efficiency, expand market access, and strengthen competitiveness. In Indonesia, Bank Indonesia reported that by October 2024, the Quick Response Code Indonesian Standard (QRIS) had reached approximately 54.1 million users and 34.7 million merchants (Bank Indonesia, 2024). The government also reported that approximately 27 million MSMEs had adopted digital technology by 2024 (Ministry of Communication and Informatics, 2024). However, technology adoption alone does not necessarily ensure business sustainability or competitiveness, as the benefits may depend on how effectively business owners use digital technologies.

Previous studies in Makassar have examined various aspects of MSME digitalization. Adriani and Yuniar (2023) investigated digital payments and financial performance, while Rakib et al. (2024), Badar et al. (2025), and Indriani and Yus (2025) examined digital literacy in relation to business existence, success, capacity building, or digital transformation. These studies establish the relevance of digital technology and digital capabilities to MSME development. Nevertheless, the relationships between digital payment adoption and marketplace use, digital literacy, and the distinct outcomes of business sustainability and competitiveness require further integrated examination.

A key issue is the distinction between adopting digital technologies and having the capabilities to use them effectively. Digital payment systems facilitate transactions, while marketplace platforms provide opportunities to reach broader markets. However, their relationships with business outcomes may differ depending on how business owners understand and utilize these technologies. Digital literacy may therefore represent an important mediating mechanism linking technology adoption with MSME sustainability and competitiveness, although this relationship requires empirical testing.

Drawing on digital transformation and resource-based perspectives, this study examines digital payment adoption and marketplace use as separate explanatory variables, digital literacy as a mediating variable, and MSME sustainability and competitiveness as distinct outcomes. By integrating these variables within a single Partial Least Squares Structural Equation Modeling (PLS-SEM) framework, the study evaluates both direct relationships and indirect effects through digital literacy.

Accordingly, this study aims to examine the relationships of digital payment adoption and marketplace use with MSME sustainability and competitiveness in Makassar City, Indonesia, and to assess the mediating role of digital literacy. The findings are expected to contribute to a more differentiated understanding of how digital technology adoption relates to MSME outcomes and provide practical insights for developing digital skills alongside access to digital payment systems and marketplace platforms.

2) Literature Review and Hypothesis Development

Theoretical Foundations

Digital transformation involves not only adopting digital technologies but also integrating them into organizational processes to improve business outcomes. For MSMEs, digital payment systems and marketplace platforms may facilitate transactions and expand market access, but their adoption does not automatically ensure greater sustainability or competitiveness. The benefits of these technologies may depend on how effectively they are incorporated into business activities and decision-making (Vial, 2019).

The Resource-Based View (RBV) explains differences in firm performance through the resources and capabilities organizations possess and how they deploy them. Digital payment systems and marketplace platforms provide MSMEs with technological resources, but access alone may not create a sustainable competitive advantage. Their value depends partly on how effectively these resources are utilized to support business processes and develop relevant capabilities (Cenamor et al., 2019).

Digital literacy refers to the knowledge and skills required to access, understand, evaluate, and use digital technologies effectively. In MSMEs, these capabilities may help business owners manage digital transactions, operate marketplace platforms, and use digital information in business activities. Accordingly, digital literacy may serve as a mediating mechanism linking technology adoption with MSME sustainability and competitiveness. It is important, however, to distinguish individual digital literacy from organizational digital capability: digital literacy concerns an individual's knowledge and skills, whereas organizational digital capability concerns the firm's ability to mobilize resources and routines to achieve business objectives.

Digital Payment Systems

Digital payment adoption refers to the use of digital financial technologies, such as mobile banking, electronic wallets, and QR-based payment systems, to facilitate business transactions. For MSMEs, these technologies can improve transaction convenience, facilitate payment processing, and provide electronic transaction records. However, their contribution to business sustainability may

depend on how effectively they are integrated into financial management and business decision-making. From a digital transformation perspective, technology creates value when it is effectively incorporated into business processes (Vial, 2019).

Digital payment adoption may also strengthen MSME competitiveness by providing convenient payment options and responding to changing customer preferences. Furthermore, using digital payment systems may expose business owners to digital tools and transaction information, potentially supporting the development of digital literacy. These relationships suggest that digital payment adoption may be associated not only with business outcomes but also with the digital skills required to utilize technology effectively.

Based on this reasoning, the following hypotheses are proposed:

H1: Digital Payment Adoption positively and significantly affects MSME Sustainability.

H2: Digital Payment Adoption positively and significantly affects MSME Competitiveness.

H5: Digital Payment Adoption positively and significantly affects Digital Literacy.

Marketplace Platforms

Marketplace platforms have become an important digital channel for MSMEs to expand their market reach, promote products, and connect with customers beyond their immediate geographical areas. Through platforms such as online marketplaces, business owners can display product information, communicate with potential buyers, and facilitate transactions without relying exclusively on physical stores. This broader market access may create opportunities for MSMEs to increase sales, diversify their customer base, and strengthen business continuity. From a digital transformation perspective, the value of digital technologies depends on how businesses incorporate them into their operations and use them to respond to changes in the business environment (Vial, 2019). Therefore, marketplace adoption may support MSME sustainability by providing additional sales channels and enabling businesses to adapt to changing consumer purchasing behavior. However, these benefits are not automatic, as businesses may face challenges related to platform fees, intense competition, order management, and dependence on third-party platforms.

In addition to supporting business continuity, marketplace platforms may influence MSME competitiveness by increasing product visibility and providing opportunities to compete in broader markets. Online platforms allow smaller businesses to present their products alongside those of larger businesses, potentially reducing some traditional barriers associated with geographical location and access to customers. Marketplace adoption may also help MSMEs respond to customer preferences through online interactions, product reviews, and transaction information. From the resource-based view, digital platforms may contribute to competitive advantage when businesses use them effectively to develop valuable capabilities and respond to market opportunities (Barney, 1991). Nevertheless, the availability of marketplace platforms does not necessarily guarantee stronger competitiveness. The outcomes may depend on how effectively MSMEs manage product differentiation, pricing, customer service, and their overall online presence. Consequently, marketplace adoption may have different implications for business sustainability and competitiveness, making both relationships important to examine empirically in the context of MSMEs in Makassar City.

Based on this reasoning, the following hypotheses are proposed:

H3: Marketplace adoption positively affects MSME sustainability.

H4: Marketplace adoption positively affects MSME competitiveness.

Digital Literacy as a Mediating Variable

Digital literacy refers to the knowledge and skills required to use digital technologies effectively in business activities. In MSMEs, digital literacy may help business owners utilize digital payment systems and marketplace platforms to improve business processes and decision-making. From a mediation perspective, digital literacy may explain how technology adoption relates to business sustainability and competitiveness (Hayes, 2018). Digital capability perspectives further emphasize the

importance of developing capabilities to leverage digital technologies for improved business outcomes (Cenamor et al., 2019).

Previous studies have highlighted the relevance of digital capabilities to technology utilization and business performance (Ferreira et al., 2019; Eller et al., 2020). In the MSME context, digital literacy may support more effective use of digital tools, potentially contributing to business sustainability and competitiveness. Research in Indonesia has also linked digital literacy with MSME development and the utilization of digital technologies (Sitaniapessy et al., 2024). Accordingly, this study examines the direct relationships between digital literacy and MSME outcomes, as well as its mediating role in the relationships between technology adoption and business outcomes.

Based on this theoretical and empirical foundation, the following hypotheses are proposed:

H7: Digital Literacy positively and significantly affects MSME Sustainability.

H8: Digital Literacy positively and significantly affects MSME Competitiveness.

H9: Digital Literacy mediates the relationship between Digital Payment Adoption and MSME Competitiveness.

H10: Digital Literacy mediates the relationship between Digital Payment Adoption and MSME Sustainability.

H11: Digital Literacy mediates the relationship between Marketplace Adoption and MSME Competitiveness.

H12: Digital Literacy mediates the relationship between Marketplace Adoption and MSME Sustainability.

MSME Sustainability

MSME sustainability is defined as the ability of a business to achieve long-term continuity by harmonizing its economic, social, and environmental aspects. Sustainable Business Model Theory posits that digital technology drives sustainability when it is integrated via pertinent organizational capabilities (Geissdoerfer et al., 2017). Through digital transformation, MSMEs can minimize waste, improve resource efficiency, and adopt paperless and circular economy practices, which collectively enhance sustainability performance (Bican & Brem, 2020). Moreover, existing literature confirms that digital literacy not only enables the application of digital tools for sustainable practices like demand forecasting and inventory optimization but also mediates the impact of technology on effective resource management (Yadegaridehkordi et al., 2020).

MSME Competitiveness

MSME competitiveness is determined by innovation capability, operational efficiency, customer experience quality, and strategic adaptation capacity. Competitive Advantage Theory in the digital context emphasizes that sustainable advantage stems from unique digital capabilities that are difficult for competitors to imitate (Bharadwaj et al., 2013). Digital payments and marketplace platforms can strengthen competitive advantage through market expansion, operational efficiency improvements, and business model innovation (Sebastian et al., 2017; Parida et al., 2019).

MSMEs gain a competitive edge by adopting digital payment systems that lower transaction costs, speed up payment processing, and offer superior customer convenience. Likewise, digital marketplaces provide an advantage through access to analytics, customer insights, and expanded market reach unattainable by traditional means. These competitive benefits are magnified by digital literacy, which empowers MSMEs to strategically deploy digital tools for data-informed decision-making and novel customer engagement. Research in the Indonesian context confirms that digital adoption combined with digital literacy enhances MSME sales growth and competitive standing (Rakib et al., 2024). This finding supports a model where digital technology directly impacts competitiveness, with digital literacy functioning as a critical mediator in these relationships.

Based on the theoretical review and previous studies discussed earlier, this research proposes the conceptual framework illustrated in Figure 1.

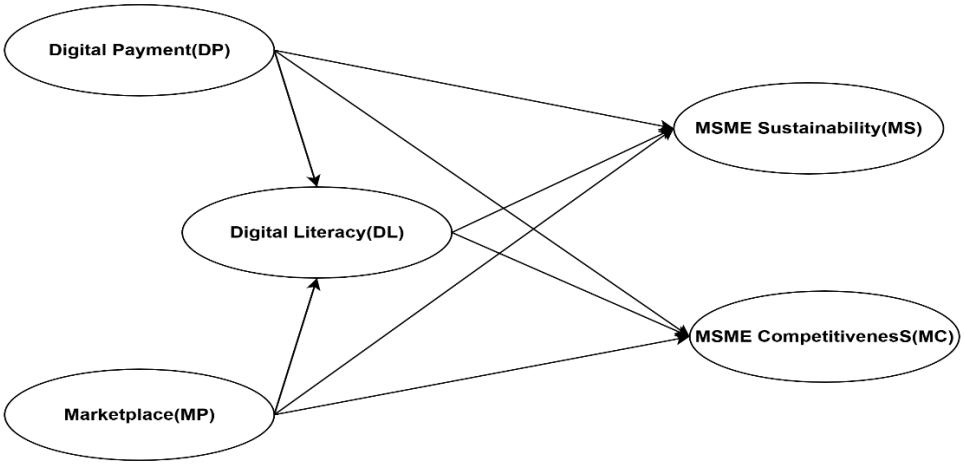


Figure 1. Conceptual Framework

This framework hypothesizes that Digital Payment and Marketplace adoption have positive effects on MSME Sustainability and MSME Competitiveness. Furthermore, it posits that these relationships are influenced both directly and indirectly, with Digital Literacy acting as a proposed mediating variable.

3) Research Method

This study employed a quantitative explanatory design to examine the direct relationships between digital payment adoption, marketplace adoption, MSME sustainability, and MSME competitiveness, as well as the mediating role of digital literacy in Makassar City, Indonesia. The study population comprised 31,848 MSMEs utilizing digital technologies, based on data from the Makassar City Office for Cooperatives and SMEs (Rayyan, 2024). Using purposive sampling, 300 MSME owners or managers were selected based on their experience using digital payment systems and marketplace platforms for at least one year and their knowledge of the businesses' digital activities.

Primary data were collected through structured questionnaires distributed online and offline. The instrument measured five constructs—digital payment adoption, marketplace adoption, digital literacy, MSME sustainability, and MSME competitiveness—using 25 indicators, with five indicators per construct. All items were assessed using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The measurement items were adapted from previous studies: digital payment adoption from Irianto and Chanvarasuth (2025) and Timur et al. (2024), marketplace adoption from Budiono et al. (2020), digital literacy from Naibaho et al. (2025), and MSME sustainability and competitiveness from Kurniasari et al. (2023) and the relevant sources identified in the original instrument.

Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 4. The measurement model was assessed using outer loadings, Cronbach's alpha, composite reliability, average variance extracted (AVE), and the heterotrait–monotrait ratio (HTMT) to evaluate reliability and validity. The structural model was evaluated using the coefficient of determination (R^2), path coefficients, t-statistics, and p-values. Bootstrapping with 5,000 resamples was used to test the significance of direct relationships and indirect effects involving digital literacy, with statistical significance evaluated at the 5% level.

4) Results and Discussion

a) *Results*

Respondent Characteristics

Table 1. Respondent Characteristics

Characteristic	Category	Frequency	Percentage (%)
Type Of Business	Food & Beverage	172	57.33
	Others	41	13.67
	Fashion & Accessories	30	10.00
	Handicrafts	28	9.33
	Services	8	2.67
	Wholesale	7	2.33
	Agriculture & Fishery	6	2.00
	Beauty & Health	6	2.00
	Digital Business	2	0.67
	Total	**300**	**100.0**
Business Operation Time	> 6 years	191	63,67
	4–6 years	75	25.00
	1–3 years	22	7.33
	< 1 year	12	4.00
	Total	**300**	**100.00**

Source: Primary data processed using SmartPLS 4. (2025)

As shown in Table 1, the food and beverage sector accounted for the largest proportion of respondents, comprising 172 businesses (57.33%). This was followed by other business sectors (13.67%), fashion and accessories (10.00%), and handicrafts (9.33%). The remaining respondents were distributed across services, wholesale, agriculture and fishery, beauty and health, and digital business. This distribution indicates that the sample was predominantly composed of food and beverage MSMEs, while other sectors were represented in smaller proportions.

Regarding business operating period, 191 respondents (63.67%) had operated their businesses for more than six years, while 75 respondents (25.00%) had operated for four to six years. Businesses operating for one to three years accounted for 22 respondents (7.33%), whereas 12 respondents (4.00%) reported an operating period of less than one year. Overall, the sample was dominated by established businesses, suggesting that most respondents had substantial experience managing their business operations. Nevertheless, business age alone does not establish the duration of digital technology use; this distinction is relevant when interpreting the sample eligibility criteria.

Table 2. Convergent Validity and Reliability Results

Construct	Indicator	Outer Loadings	AVE	CR	Cronbach's Alpha
Digital Payment	DP1	0.835	0.716	0.904	0.901
	DP2	0.843			
	DP3	0.849			
	DP4	0.866			
	DP5	0.838			
Marketplace	MP1	0.834	0.720	0.908	0.903
	MP2	0.855			
	MP3	0.867			
	MP4	0.818			
	MP5	0.869			
Digital Literacy	DL1	0.862	0.726	0.906	0.905
	DL2	0.850			
	DL3	0.856			

	DL4	0.858			
	DL5	0.833			
MSME Sustainability	MS1	0.869	0.733	0.909	0.909
	MS2	0.853			
	MS3	0.846			
	MS4	0.845			
	MS5	0.865			
MSME Competitiveness	MC1	0.817	0.699	0.895	0.892
	MC2	0.835			
	MC3	0.844			
	MC4	0.843			
	MC5	0.842			

Source: Primary data processed using SmartPLS 4. (2025)

The results demonstrate that all 25 indicators met the recommended outer-loading criterion, with values ranging from 0.817 to 0.869. Among the five constructs, MSME sustainability recorded the highest AVE value (0.733), followed by digital literacy (0.726), marketplace adoption (0.720), digital payment (0.716), and MSME competitiveness (0.699). These values indicate that each construct explained more than 50% of the variance in its respective indicators.

Regarding reliability, composite reliability values ranged from 0.895 to 0.909, while Cronbach's alpha values ranged from 0.892 to 0.909. All values exceeded the recommended threshold of 0.70, indicating that the indicators demonstrated satisfactory internal consistency. Overall, the results support the reliability and convergent validity of the measurement model, allowing the analysis to proceed to discriminant validity assessment.

Table 3. Heterotrait-Monotrait (HTMT) Ratio Results

	Digital Literacy	Digital Payment	MSME Competitiveness	MSME Sustainability	Marketplace
Digital Literacy	-				
Digital Payment	0.624	-			
MSME Competitiveness	0.774	0.775	-		
MSME Sustainability	0.708	0.416	0.567	-	
Marketplace	0.693	0.292	0.418	0.681	-

Source: Primary data processed using SmartPLS 4. (2025)

The HTMT values ranged from 0.292 to 0.775, with the highest value observed between digital payment and MSME competitiveness (0.775), followed by digital literacy and MSME competitiveness (0.774). Although these pairs showed relatively stronger associations than the other constructs, their HTMT values remained below the 0.85 threshold. The lowest value was observed between digital payment and marketplace adoption (0.292).

These findings indicate that digital payment adoption, marketplace adoption, digital literacy, MSME sustainability, and MSME competitiveness represent empirically distinguishable constructs. Therefore, the results support the discriminant validity of the measurement model, providing a basis for proceeding to the structural model assessment.

Table 4. R-square Result

Characteristic	R-square	R-square adjusted
Digital Literacy	0.567	0.564
MSME Sustainability	0.495	0.490
MSME Competitiveness	0.603	0.599

Source: Primary data processed using SmartPLS 4. (2025)

As shown in Table 4, the model explained 56.7% of the variance in digital literacy, with an adjusted (R^2) of 56.4%. This indicates that digital payment and marketplace adoption jointly explained more than half of the variance in digital literacy. For MSME sustainability, the (R^2) value of 0.495 indicates that the predictor variables in the model explained 49.5% of its variance, while the adjusted value was 49.0%. The remaining variance may be associated with factors outside the proposed model. Meanwhile, MSME competitiveness recorded the highest (R^2) value of 0.603, with an adjusted (R^2) of 0.599, indicating that the model explained 60.3% of the variance in competitiveness.

Overall, the three endogenous constructs demonstrated meaningful explanatory power within the proposed model. MSME competitiveness had the highest explained variance, followed by digital literacy and MSME sustainability. These results provide a basis for examining the individual hypothesized relationships through structural path analysis.

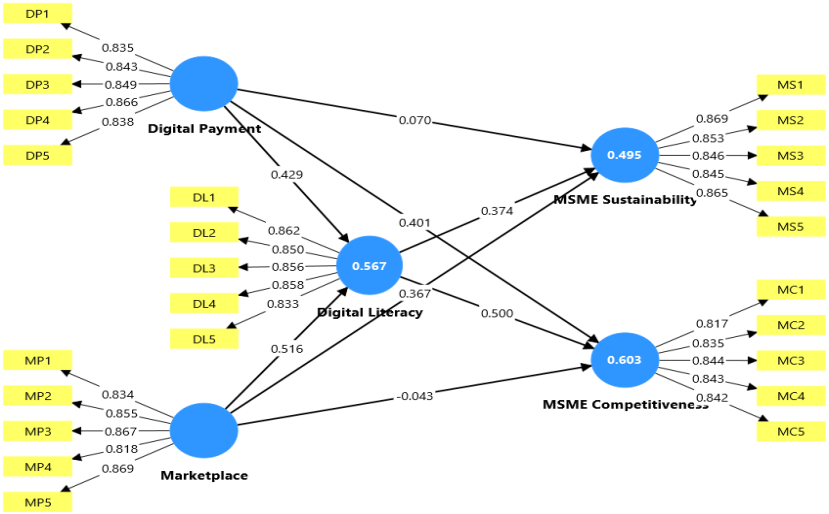


Figure 2. PLS-SEM Structural Model

Table 5. Structural Model Assessment and Direct Effects

Hypothesis	Path	Path Coefficient (β)	T-Statistics	P-Values	Result
Direct Effects					
H1	Digital Payment → MSME Sustainability	0.070	1.245	0.213	Not Supported
H2	Digital Payment → MSME Competitiveness	0.401	8.840	0.000	Supported
H3	Marketplace → MSME Sustainability	0.367	5.975	0.000	Supported
H4	Marketplace → MSME Competitiveness	-0.043	0.613	0.540	Not Supported
H5	Digital Payment → Digital Literacy	0.429	10.791	0.000	Supported
H6	Marketplace → Digital Literacy	0.516	12.078	0.000	Supported
H7	Digital Literacy → MSME Sustainability	0.374	5.240	0.000	Supported
H8	Digital Literacy → MSME Competitiveness	0.500	6.837	0.000	Supported

Source: Primary data processed using SmartPLS 4; bootstrapping with 5,000 resamples.

The results in Table 5 show that six of the eight hypothesized direct relationships were statistically significant. Digital payment adoption positively affected MSME competitiveness (β = 0.401, p < 0.001) and digital literacy (β = 0.429, p < 0.001), supporting H2 and H5. Marketplace adoption positively affected MSME sustainability (β = 0.367, p < 0.001) and digital literacy (β = 0.516, p < 0.001), supporting H3 and H6. Digital literacy also positively affected MSME sustainability (β = 0.374, p < 0.001) and competitiveness (β = 0.500, p < 0.001), supporting H7 and H8.

However, digital payment adoption had no significant direct effect on MSME sustainability (β = 0.070, p = 0.213), while marketplace adoption had no significant direct effect on competitiveness (β = −0.043, p = 0.540). Therefore, H1 and H4 were not supported. These findings indicate that the direct relationships between technology adoption and MSME outcomes vary by technology and outcome, providing a basis for examining the mediating role of digital literacy.

Table 6. Mediation Analysis Results

Hypothesis	*Indirect Relationship*	*Path Coefficient (β)*	*t-statistic*	*p-value*	*Result*
H9	*Digital Payment → Digital Literacy → MSME Competitiveness*	*0.214*	*6.260*	*<0.001*	*Supported*
H10	*Digital Payment → Digital Literacy → MSME Sustainability*	*0.160*	*4.865*	*<0.001*	*Supported*
H11	*Marketplace Adoption → Digital Literacy → MSME Competitiveness*	*0.258*	*5.511*	*<0.001*	*Supported*
H12	*Marketplace Adoption → Digital Literacy → MSME Sustainability*	*0.193*	*4.635*	*<0.001*	*Supported*

Source: Primary data processed using SmartPLS 4; bootstrapping with 5,000 resamples.

The results in Table 5 show that six of the eight hypothesized direct relationships were statistically significant. Digital payment adoption positively affected MSME competitiveness (β = 0.401, p < 0.001) and digital literacy (β = 0.429, p < 0.001), supporting H2 and H5. Marketplace adoption positively affected MSME sustainability (β = 0.367, p < 0.001) and digital literacy (β = 0.516, p < 0.001), supporting H3 and H6. Digital literacy also positively affected MSME sustainability (β = 0.374, p < 0.001) and competitiveness (β = 0.500, p < 0.001), supporting H7 and H8.

However, digital payment adoption had no significant direct effect on MSME sustainability (β = 0.070, p = 0.213), while marketplace adoption had no significant direct effect on competitiveness (β = −0.043, p = 0.540). Therefore, H1 and H4 were not supported. These findings indicate that the direct relationships between technology adoption and MSME outcomes vary by technology and outcome, providing a basis for examining the mediating role of digital literacy.

b) **Discussion**

The Effect of Digital Payment Adoption on MSME Sustainability

The findings indicate that digital payment adoption does not have a significant direct effect on MSME sustainability in Makassar City (β = 0.070, p = 0.213); therefore, H1 is not supported. This result suggests that adopting digital payment systems alone may not be sufficient to strengthen business sustainability. Although digital payments can facilitate transactions and improve operational efficiency (Senyo et al., 2019), their contribution to long-term business sustainability may depend on how effectively they are integrated into broader business management practices (Vial, 2019).

Nevertheless, the indirect effect of digital payment adoption on MSME sustainability through digital literacy is positive and significant (β = 0.160, p < 0.001). This finding suggests that digital literacy may serve as an important mechanism through which digital payment adoption relates to business sustainability. Consistent with Aulia et al. (2022), the potential benefits of digital payment systems may extend beyond transaction processing when business owners can use digital tools and related information effectively.

The Effect of Marketplace Adoption on MSME Sustainability

The findings show that marketplace adoption has a positive and significant effect on MSME sustainability in Makassar City (β = 0.367, p < 0.001); therefore, H3 is supported. This result suggests that marketplace platforms can help MSMEs expand their market reach beyond geographical limitations and access a broader customer base. The finding is consistent with previous studies highlighting the role of digital platforms in supporting business opportunities and market expansion (Nambisan et al., 2019; Quinton et al., 2018).

From a Resource-Based View perspective, marketplace platforms provide access to digital resources that MSMEs may find difficult to develop independently (Cenamor et al., 2019). However, the positive relationship observed in this study should not be interpreted as proof that marketplace adoption automatically ensures long-term survival. Rather, the finding indicates that marketplace adoption is associated with stronger MSME sustainability, while the extent of its benefits may depend on how effectively businesses utilize these platforms.

The Effect of Digital Payment Adoption on MSME Competitiveness

The findings reveal that digital payment adoption has a positive and significant effect on MSME competitiveness in Makassar City ($\beta = 0.401$, $p < 0.001$); therefore, H2 is supported. This result suggests that providing digital payment options may help MSMEs improve transaction convenience and respond to customers' payment preferences. The finding is consistent with the view that digital technologies can support business competitiveness by improving operational processes and customer interactions (Bharadwaj et al., 2013).

However, the findings establish a significant relationship between digital payment adoption and competitiveness, rather than proving that improvements in customer experience or transaction efficiency directly caused higher competitiveness. The result indicates that digital payment adoption is a relevant factor associated with MSME competitiveness in Makassar City, while its benefits may also depend on how effectively businesses integrate digital tools into their operations.

The Effect of Marketplace Adoption on MSME Competitiveness

The findings indicate that marketplace adoption does not have a significant direct effect on MSME competitiveness in Makassar City ($\beta = -0.043$, $p = 0.540$); therefore, H4 is not supported. This result suggests that merely using marketplace platforms does not necessarily distinguish an MSME from its competitors. When businesses have access to similar platforms, competitiveness may depend on how effectively they use available digital resources rather than on platform adoption alone.

From a Resource-Based View perspective, access to a digital platform may not provide a sustained competitive advantage if competing businesses can access the same resource (Cenamor et al., 2019). Nevertheless, this interpretation should be treated cautiously because the study did not directly measure the uniqueness of marketplace resources. The significant indirect effect through digital literacy ($\beta = 0.258$, $p < 0.001$) further suggests that digital literacy may be an important pathway linking marketplace adoption with MSME competitiveness.

The Effect of Digital Payment Adoption on Digital Literacy

The findings indicate that digital payment adoption has a positive and significant effect on digital literacy ($\beta = 0.429$, $p < 0.001$); therefore, H5 is supported. This result suggests that the use of digital payment systems is positively associated with digital literacy among MSMEs in Makassar City. Using these systems may provide business owners with opportunities to engage with digital tools and develop their understanding of digital transactions.

This finding highlights the potential relationship between technology adoption and the development of digital capabilities. However, the result does not establish that adopting digital payments automatically increases digital literacy, because the analysis identifies an association rather than a causal change over time. The finding nevertheless supports the importance of considering digital literacy when examining how MSMEs use digital payment technologies.

The Effect of Marketplace Adoption on Digital Literacy

The findings show that marketplace adoption has a positive and significant effect on digital literacy among MSMEs in Makassar City ($\beta = 0.516$, $p < 0.001$); therefore, H6 is supported. This result indicates that MSMEs' use of marketplace platforms is positively associated with their digital literacy. Engaging with these platforms may expose business owners to digital activities related to product presentation, online transactions, and customer interaction.

The coefficient for marketplace adoption is higher than that for digital payment adoption in predicting digital literacy. This suggests that, within the proposed model, marketplace adoption has a stronger relationship with digital literacy. However, the findings do not establish which specific marketplace activities contribute to digital literacy development, as these activities were not separately tested. The result emphasizes the relevance of digital literacy in understanding MSMEs' engagement with digital platforms.

The Effect of Digital Literacy on MSME Sustainability

The findings reveal that digital literacy has a positive and significant effect on MSME sustainability in Makassar City ($\beta = 0.374$, $p < 0.001$); therefore, H7 is supported. This result indicates that digital literacy is an important factor associated with MSME sustainability. Business owners who are better equipped to understand and use digital technologies may be better positioned to utilize digital resources in managing their businesses.

This finding emphasizes that the benefits of digital transformation may depend not only on technology adoption but also on the capabilities of the people using it. In the context of MSMEs, digital literacy may help business owners make more effective use of digital tools to support business activities. Nevertheless, the result establishes a significant relationship and does not independently demonstrate that digital literacy guarantees long-term business sustainability.

The Effect of Digital Literacy on MSME Competitiveness

The findings indicate that digital literacy has a positive and significant effect on MSME competitiveness in Makassar City ($\beta = 0.500$, $p < 0.001$); therefore, H8 is supported. This result suggests that digital literacy is an important factor associated with MSMEs' ability to compete. The ability to understand and use digital technologies may help business owners utilize digital resources more effectively in responding to market demands.

Among the direct predictors of MSME competitiveness in the proposed model, digital literacy has a positive coefficient of 0.500, while digital payment adoption has a coefficient of 0.401 and marketplace adoption has a non-significant coefficient of −0.043. This pattern highlights the relevance of digital literacy alongside technology adoption. However, these findings should be interpreted as relationships within the estimated model rather than evidence that digital literacy alone determines MSME competitiveness.

The Mediating Role of Digital Literacy in the Relationship between Digital Payment Adoption and MSME Sustainability and Competitiveness

The findings indicate that digital literacy significantly mediates the relationships between digital payment adoption and both MSME competitiveness ($\beta = 0.214$, $p < 0.001$) and MSME sustainability ($\beta = 0.160$, $p < 0.001$). Therefore, H9 and H10 are supported. These results suggest that digital literacy represents an important indirect pathway linking digital payment adoption with MSME outcomes. While digital payments facilitate digital transactions, the ability to understand and use digital technologies may help business owners derive broader benefits from their adoption.

These findings highlight that the relationship between digital payment adoption and MSME outcomes involves more than the availability of payment technology. Digital literacy may help explain how digital payment adoption relates to business sustainability and competitiveness. However, determining whether the mediation is full or partial requires jointly assessing the corresponding direct and indirect effects and their bootstrap confidence intervals. The significant indirect effects alone are insufficient to establish the type of mediation.

5) Conclusion

This study examined the relationships between digital payment adoption, marketplace adoption, digital literacy, MSME sustainability, and MSME competitiveness in Makassar City. The findings show that digital payment adoption positively and significantly affects competitiveness but has no significant direct effect on sustainability. Marketplace adoption positively and significantly affects sustainability but has no significant direct effect on competitiveness. Digital payment and marketplace adoption are positively associated with digital literacy, which also has significant positive relationships with both MSME outcomes.

The mediation analysis further reveals that digital literacy significantly mediates the relationships between digital payment and marketplace adoption and both MSME sustainability and competitiveness. These findings highlight the importance of digital literacy in understanding how technology adoption relates to MSME outcomes. In practice, MSME development initiatives should complement digital technology adoption with training that strengthens business owners' ability to use digital tools effectively. Such initiatives may include digital transaction management, online marketing, and the use of digital information for business decisions.

This study is limited to MSMEs in Makassar City, which may restrict the generalizability of the findings to other regions. Future research could include MSMEs from different geographical settings

and employ longitudinal or qualitative approaches to examine how digital literacy develops and how it relates to business sustainability and competitiveness over time.

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Conflict of Interest

The authors declare that they do not have any conflict of interest.

Statement on the Use of Generative AI

During the preparation of this work, the author used ChatGPT to assist in improving clarity and readability of the text. The author reviewed and edited the output and takes full responsibility for the content of the publication.

Author contributions

The authors contributed to the conceptualization, methodology, data collection, formal analysis, and writing of this study. All authors contributed to the development of the research, analysis and interpretation of the findings, and preparation of the manuscript. All authors have read and approved the final version of the manuscript.

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