Digital-Based MSME Empowerment Strategy and Local Economic Strengthening: An SEM Approach in Medan City

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Abstrak. *Usaha Mikro, Kecil, dan Menengah (UMKM) merupakan pilar utama pembangunan ekonomi Indonesia yang berperan penting dalam penciptaan lapangan kerja, pemerataan pendapatan, dan peningkatan Produk Domestik Bruto (PDB). Namun, di era ekonomi digital, UMKM masih menghadapi berbagai hambatan struktural seperti rendahnya literasi digital, keterbatasan infrastruktur teknologi, akses pembiayaan yang minim, serta kemampuan pemasaran digital yang belum optimal. Penelitian ini bertujuan untuk mengkaji strategi pemberdayaan UMKM berbasis digital dalam memperkuat ekonomi lokal di Kota Medan. Pendekatan kuantitatif digunakan melalui metode survei terhadap pelaku UMKM, dengan analisis data menggunakan Structural Equation Modeling–Partial Least Squares (SEM-PLS). Hasil penelitian menunjukkan bahwa literasi digital ($\beta = 0.65$, $p < 0.01$), infrastruktur digital ($\beta = 0.58$, $p < 0.01$), dan dukungan kebijakan ($\beta = 0.60$, $p < 0.01$) berpengaruh signifikan terhadap adopsi teknologi. Adopsi teknologi tersebut selanjutnya meningkatkan strategi pemasaran digital ($\beta = 0.62$, $p < 0.001$) dan kinerja UMKM ($\beta = 0.72$, $p < 0.001$), di mana strategi pemasaran digital menjadi faktor paling dominan ($\beta = 0.80$, $p < 0.001$). Dengan daya jelaskan model yang kuat ($R^2 = 0.68$ untuk adopsi teknologi; $R^2 = 0.74$ untuk kinerja UMKM), studi ini menegaskan bahwa keberhasilan transformasi digital UMKM tidak hanya bergantung pada kemampuan teknis, tetapi juga pada ekosistem pendukung yang mencakup kebijakan pemerintah, kesiapan infrastruktur, dan pelatihan digital berkelanjutan. Rekomendasi utama meliputi penguatan literasi digital, pemberian insentif fiskal, peningkatan akses fintech, adopsi QRIS, serta kemitraan dengan platform e-commerce guna meningkatkan daya saing dan ketahanan ekonomi UMKM di era transformasi digital.*

Kata kunci: *UMKM; Pemberdayaan Digital; Ekonomi Lokal; Literasi Digital; Strategi Pemasaran Digital.*

Abstract. *Micro, Small, and Medium Enterprises (MSMEs) serve as key pillars of Indonesia's economic development, significantly contributing to employment, income equity, and Gross Domestic Product (GDP) growth. However, in the digital economy era, many MSMEs continue to struggle with structural barriers such as low digital literacy, inadequate technological infrastructure, limited financing access, and weak digital marketing capabilities. This study aims to examine digital-based empowerment strategies for strengthening the local economy in Medan City. Employing a quantitative research design through a survey method, data were collected from MSME actors and analyzed using Structural Equation Modeling–Partial Least Squares (SEM-PLS). The findings reveal that digital literacy ($\beta = 0.65$, $p < 0.01$), digital infrastructure ($\beta = 0.58$, $p < 0.01$), and policy support ($\beta = 0.60$, $p < 0.01$) significantly influence technology adoption, which subsequently enhances digital marketing strategies ($\beta = 0.62$, $p < 0.001$) and MSME performance ($\beta = 0.72$, $p < 0.001$). Digital marketing strategy emerges as the most influential factor ($\beta = 0.80$, $p < 0.001$), with strong explanatory power ($R^2 = 0.68$ for technology adoption; $R^2 = 0.74$ for MSME performance). The results indicate that successful MSME digital transformation requires not only technical competence but also an enabling ecosystem involving policy support, infrastructure readiness, and continuous digital training. The study recommends integrated empowerment initiatives through digital literacy education, fiscal incentives, fintech access, QRIS adoption, and e-commerce partnerships to enhance MSME competitiveness and economic resilience in Medan's digital transformation era.*

Keywords: *MSMEs; Digital Empowerment; Local Economy; Digital Literacy; Digital Marketing Strategy.*

Introduction

Micro, small, and medium enterprises play a crucial role in supporting the local and national economy, especially amid fluctuating economic challenges (Soegoto *et al.*, 2020). This sector has proven to be adaptive and resilient, capable of creating jobs, distributing income, and driving local innovation (Panggabean *et al.*, 2024). Its existence is vital in reducing poverty and unemployment, and serves as the backbone of the people's economic system (Helmalia & Afrinawati, 2018). In Indonesia, MSMEs contribute significantly to the Gross Domestic Product and labor absorption, making them a priority in the economic development agenda (Mawardi & Abizar, 2021). However, SMEs often face challenges in mastering technology and accessing broader markets, hindering their productivity and competitiveness in the digital era (Chairi *et al.*, 2022). Therefore, digital-based empowerment strategies are imperative to enhance SMEs' capacity to compete in the modern economic landscape and contribute more significantly to regional welfare (Vinatra, 2023).

Empowering MSMEs through digital platforms has great potential to expand market reach, improve operational efficiency, and drive product innovation (Ikhsan & Hasan, 2020). The importance of these SME empowerment efforts is further emphasized given their significant potential to boost regional economic growth, as seen in the city of Manado, where SMEs play a central role in accelerating regional development (Soegoto *et al.*, 2020). However, to enable SMEs to "level up" and contribute more optimally, digital economic literacy and technology utilization are key, as digital adoption can increase revenue by up to 80% (Erlanitasari *et al.*, 2020). This study will analyze digital-based SME empowerment strategies in the city of Medan for strengthening the local economy, with a focus on utilizing structural equation modeling to identify key variables influencing the success of digital adoption and its impact on SME income. Previous research has shown that the digital economy significantly impacts SME income, with digital literacy as a crucial moderating variable (Wijaya & Nailufaroh,

2022). This study will explore in depth how digital infrastructure and digital economic literacy can mediate the impact of financing digitalization on the operational effectiveness of MSMEs, as well as their role in product innovation (Sipayung, 2025). This approach is expected to provide a comprehensive understanding of the mechanisms of digitalization in promoting the competitiveness of MSMEs in Medan City. The application of the SEM model will enable the simultaneous identification of causal relationships between variables, providing a more holistic insight into the factors driving the success of SME digitalization. The use of SEM will also help in formulating more targeted policy recommendations for local governments and other stakeholders in supporting SME digital transformation. This study aims to fill the literature gap by specifically analyzing the role of digital literacy, technological infrastructure, and policy support in accelerating technology adoption by SMEs in Medan City.

Specifically, this study will examine how the application of information technology, such as accounting information systems and e-commerce, affects the operational efficiency and market access of MSMEs, as well as the challenges faced in the adoption process (Santi *et al.*, 2024). This study will also consider how comprehensive empowerment strategies, including digital literacy training and facilitating access to digital financing, can significantly enhance the capabilities of MSMEs in Medan City to compete in the digital economy ecosystem (Sipayung, 2025). This research will adapt the successful DeLone and McLean information system model combined with Structural Equation Modeling to analyze relevant variables correlated with increased SME profits (Soegoto *et al.*, 2019). Through this approach, the research will provide a deep understanding of how information system components, service quality, and the net impact of digital adoption synergistically influence SME financial performance, while identifying the most effective policy intervention potentials (Sipayung, 2025). The primary objective of this research is to formulate an adaptive and sustainable digital-based SME empowerment model, with a focus on enhancing competitiveness through optimizing digital

literacy and leveraging online platforms. More specifically, this study will investigate the relationship between the adoption of information and communication technology and the understanding of digital transformation on business opportunities, which then has implications for the growth of SME assets in Medan City (Hardi & Arifin, 2023). This study will also evaluate the challenges faced by MSMEs in adopting digital technology, including limitations in employee digital literacy and cybersecurity issues (Patria *et al.*, 2023) (Lubis, 2024). This study aims to provide targeted policy recommendations to encourage the adoption of digital technology among MSMEs, thereby strengthening the local economy in Medan City in a sustainable manner. The design of a product marketing application based on local wisdom is expected to reduce operational costs and product promotion, thereby increasing profit margins (Salahuddin, 2021). This is supported by previous findings indicating that 80.6% of SMEs benefited from digital sales and marketing to sustain their businesses during the pandemic, and that business process digitalization can improve market and operational efficiency (Apriani *et al.*, 2023) (Islami *et al.*, 2021).

Additionally, this study will identify the determining factors driving the success of SMEs' transition to the digital realm, including support from the innovation ecosystem and government policies that are pro-SME (Kusumawati, 2022). This aligns with Bank Indonesia's efforts to promote SME development through digitalization programs as an accelerator of digital transformation (Anggarini, 2022). In this context, the study will highlight the importance of comprehensive digital marketing training programs to enhance the competitiveness of SMEs, as successfully implemented in SMEs under the guidance of Lazismu Kota Medan (Afandi *et al.*, 2023). This approach has great potential to overcome the challenges of marketing MSME products, especially in reaching a wider market and increasing competitiveness in the digital economy era (Pratiwi *et al.*, 2021). The use of social media as a digital marketing strategy, for example, has proven effective in expanding the

market reach of SMEs, although many SME operators have yet to fully optimize this potential (Sari & Setiyana, 2020). Therefore, this study will examine strategies for optimizing the use of social media as a digital marketing tool for SMEs in Medan City, with a focus on increasing sales volume and transactions (Anggraini *et al.*, 2022) (Harini *et al.*, 2022). Additionally, this study will analyze the main barriers to digital technology adoption by SMEs, including capital constraints, lack of digital skills, and concerns about data security, which often hinder their participation in the digital ecosystem (Lubis, 2024). The adoption of digital technology is crucial given the changing consumer behavior dominated by the millennial generation, where e-commerce platforms and digital payments are increasingly becoming the primary choice for fulfilling needs (Abubakar & Handayani, 2022). This study identifies the factors influencing the adoption of digital technology by SMEs in Medan City, the strengths, weaknesses, opportunities, and threats faced by SMEs in the digitalization process in Medan City, and effective digital empowerment strategies that are appropriate for the characteristics of local SMEs in Medan City.

Literature Review

The Concept of Micro, Small, and Medium Enterprises (MSMEs)

Micro, Small, and Medium Enterprises (MSMEs) are vital sectors in the Indonesian economy that make a significant contribution to the Gross Domestic Product (GDP) and labor absorption (Mawardi & Abizar, 2021). MSMEs are defined based on certain criteria, such as the number of assets, turnover, and the number of workers. According to Law No. 20 of 2008 concerning MSMEs, micro businesses have assets of up to Rp50 million and a maximum annual turnover of Rp300 million; small businesses have assets of IDR 50 million to IDR 500 million with a turnover of IDR 300 million to IDR 2.5 billion; while medium businesses have assets of IDR 500 million to IDR 10 billion with a turnover of IDR 2.5 billion to IDR 50 billion. The existence of MSMEs is very important in reducing poverty

and unemployment, and functions as the backbone of the people's economic system (Helmalia & Afrinawati, 2018). This sector has been proven to be adaptive and resilient, able to create jobs, distribute income, and encourage local innovation (Panggabean *et al.*, 2024). In Indonesia, MSMEs not only play a role in national economic growth, but also in regional economic development. In the city of Medan, in particular, MSMEs are the driving force of the local economy with various superior products based on local wisdom that have wide market potential. Nevertheless, MSMEs often face various challenges in mastering technology and access to wider markets, which hinder their productivity and competitiveness in the digital era (Chairi *et al.*, 2022). The main challenges faced by MSMEs include limited capital, access to financing, managerial skills, digital literacy, and adequate technological infrastructure. Therefore, digital-based empowerment strategies are imperative to increase the capacity of MSMEs to compete in the modern economic landscape and contribute more significantly to regional welfare (Vinatra, 2023).

MSME Empowerment
MSME empowerment is a series of efforts made to increase the capacity, skills, and competitiveness of micro, small, and medium enterprises so that they can develop and be sustainable. This empowerment includes various aspects, ranging from improving technical and managerial skills, access to capital, to the use of technology (Ikhsan & Hasan, 2020). In the context of the digital economy, MSME empowerment does not only focus on production aspects, but also on marketing, distribution, and financial management capabilities based on digital technology. Empowering MSMEs through digital platforms has great potential to expand market reach, improve operational efficiency, and encourage product innovation (Ikhsan & Hasan, 2020). The importance of MSME empowerment efforts is increasingly emphasized considering its significant potential in encouraging regional economic growth, as seen in Manado City where MSMEs play a central role in accelerating regional development (Soegoto *et al.*, 2020).

An effective empowerment program should include digital literacy training, technical mentoring, facilitation of access to e-commerce platforms, and conducive policy support. Comprehensive empowerment strategies include digital literacy training, facilitation of access to digital financing, assistance in the use of e-commerce platforms, and human resource capacity development (Sipayung, 2025). The empowerment program must also consider the local characteristics of MSMEs, the potential of regional superior products, and the local business ecosystem. Collaboration between governments, universities, financial institutions, and the private sector is indispensable to create a holistic and sustainable empowerment ecosystem.

Digitization of MSMEs
Digitalization of MSMEs refers to the process of transforming traditional businesses into business models that utilize digital technology in various operational aspects, ranging from production, marketing, distribution, to financial management (Erlanitasari *et al.*, 2020). Digitalization is not just the use of technology, but a fundamental change in the way of doing business that involves mindsets, business processes, and operational models. In the era of the digital economy, MSMEs that are able to adapt to technology have a greater chance of surviving and developing. Research shows that digital adoption can increase MSME income by up to 80% (Erlanitasari *et al.*, 2020). Digitalization allows MSMEs to reach a wider market, improve operational efficiency, reduce transaction costs, and increase competitiveness. Digital platforms such as marketplaces, social media, and digital payment systems have opened up new opportunities for MSMEs to grow. The use of information technology, such as accounting information systems and e-commerce, has a significant effect on operational efficiency and market access for MSMEs (Santi *et al.*, 2024). The adoption of digital technology by MSMEs includes various components, including: (1) the use of digital devices (smartphones, computers, tablets); (2) internet connectivity; (3) e-commerce platforms and marketplaces; (4) social media for marketing; (5) digital payment systems such as QRIS; (6) business management applications;

and (7) cloud computing technology (Anggarini, 2022). The implementation of QRIS (Quick Response Code Indonesian Standard), for example, not only facilitates non-cash transactions but also expands market reach, improves operational efficiency, and supports financial inclusion for MSMEs.

Digital Literacy

Digital literacy is defined as the ability of individuals to use, understand, evaluate, and create digital content safely and responsibly (Wijaya & Nailufaroh, 2022). In the context of MSMEs, digital literacy includes the ability to use digital devices, access the internet, utilize e-commerce platforms, conduct digital transactions, use social media for marketing, and understand cybersecurity and data protection. Digital literacy is not only about technical capabilities, but also a strategic understanding of how technology can be used to improve business performance. Research shows that digital literacy functions as a crucial moderation variable in influencing the impact of digitalization on MSME income (Wijaya & Nailufaroh, 2022). MSME actors with good digital literacy are better able to adopt new technologies, take advantage of digital market opportunities, and manage cybersecurity risks. On the contrary, low digital literacy is one of the main obstacles to the adoption of digital technology by MSMEs (Patria *et al.*, 2023). Therefore, a structured and sustainable digital literacy training program is very important in supporting the digital transformation of MSMEs. Digital economy literacy includes understanding the concept of digital economy, digital business models, digital marketing, e-commerce, and financial technology (fintech). To enable MSMEs to 'upgrade' and contribute more optimally, digital economy literacy and technology utilization are key, because digital adoption can increase revenue by up to 80% (Erlanitasari *et al.*, 2020). A comprehensive digital marketing training program has been proven to increase the competitiveness of MSMEs, as successfully implemented in MSMEs fostered by Lazismu Medan City (Afandi *et al.*, 2023).

Digital Infrastructure

Digital infrastructure refers to the availability and accessibility of information and communication technology that supports digital business activities, including internet networks, hardware, software, digital platforms, and electronic payment systems (Sipayung, 2025). Adequate digital infrastructure is an important prerequisite for the successful digitalization of MSMEs. Without adequate infrastructure, digitalization efforts will face fundamental obstacles that hinder digital transformation. Quality digital infrastructure allows MSMEs to access e-commerce platforms, conduct digital transactions, communicate with customers, and manage business operations efficiently. Studies show that digital infrastructure and digital economy literacy can mediate the impact of financing digitalization on the operational effectiveness of MSMEs, as well as their role in product innovation (Sipayung, 2025). Stable internet availability, adequate connection speeds, and affordable prices are important factors in driving the adoption of digital technology by MSMEs. Increasing internet penetration in Indonesia, government support for the digitalization of MSMEs, and consumer trends that increasingly rely on e-commerce create significant opportunities to expand the market (Sipayung, 2025; Anita, 2022). However, the digital infrastructure gap between urban and rural areas, as well as between MSMEs that have been digitized and those that are still conventional, is still a challenge that needs to be overcome. Digital infrastructure equity programs, internet access subsidies, and the provision of technology facilities are important to support the digital inclusion of MSMEs.

Policy Support

Government policy support plays a vital role in encouraging the digital transformation of MSMEs. Conducive policies include adaptive regulations, fiscal and non-fiscal incentives, training and mentoring programs, and facilitation of access to technology and financing (Rahmi & Yuzaria, 2021). The government, both at the central and regional levels, has a responsibility to create an inclusive and sustainable digital ecosystem for MSMEs. Local government policies and private initiatives, such as seminars, workshops, and digital marketing training, have been proven to accelerate digital penetration among MSMEs

(Widyo *et al.*, 2023; Aprilia *et al.*, 2025). The payment digitalization program promoted by Bank Indonesia, for example through the implementation of QRIS, has had a positive impact on accelerating the digital transformation of MSMEs (Anggarini, 2022). This policy not only facilitates cashless transactions, but also opens up access to a wider digital financial ecosystem. Effective policy support should include: (1) regulations that support the digital economy; (2) tax incentives for digitalized MSMEs; (3) subsidies or technology access assistance; (4) continuous training and mentoring programs; (5) facilitating access to e-commerce platforms; (6) consumer protection and security of digital transactions; and (7) multi-stakeholder collaboration between the government, the private sector, universities, and financial institutions. Identifying the determinants that drive the successful transition of MSMEs to the digital realm is very important, including support from the innovation ecosystem and pro-MSME government policies (Kusumawati, 2022).

Adoption of Digital Technology

The adoption of digital technology by MSMEs is a process in which business actors begin to use and integrate digital technology in their business operations. Technology adoption does not happen instantly, but through several stages, ranging from awareness, interest, evaluation, trial, to full adoption. The success of technology adoption is influenced by a variety of internal and external factors. Internal factors that affect technology adoption include digital literacy, technology readiness, leadership support, business owner characteristics such as age, education, and experience, and entrepreneurial orientation (Putong, 2023; Vrontis *et al.*, 2022). Business owners with good digital literacy are better prepared to adopt technology and understand the strategic benefits of digitalization. Psychological factors such as resistance to change and the influence of social networks also influence the adoption of technology (Karunia *et al.*, 2021; Lubis, 2024). External factors include government policy support, digital infrastructure, market competition, and training and mentoring programs. Research shows that perceived ease

of use and perceived usefulness have a significant effect on the intention to adopt digital technology (Sengaji & Radiansyah, 2022). The Technology Acceptance Model (TAM) is often used to analyze the factors that influence technology adoption. In addition, entrepreneurial orientation also acts as a moderation variable that strengthens the influence of digital literacy on technology adoption (Vrontis *et al.*, 2022).

Digital Marketing Strategy

Digital marketing is a marketing effort that uses digital media and internet technology to reach consumers and promote products or services (Sari & Setiyana, 2020). Digital marketing strategies include the use of social media, marketplaces, search engine optimization (SEO), content marketing, email marketing, and digital advertising. In the era of digital economy, the ability of MSMEs to utilize digital marketing is a key factor in improving competitiveness and business performance. The use of social media as a digital marketing strategy has proven to be effective in expanding the reach of the MSME market, although many MSME actors have not fully optimized this potential (Sari & Setiyana, 2020). Social media platforms such as Instagram, Facebook, TikTok, and WhatsApp Business allow MSMEs to interact directly with consumers, build brand awareness, and increase sales at a relatively low cost. Research shows that 80.6% of MSMEs benefit from digital sales and marketing to sustain their business during the pandemic (Apriani *et al.*, 2023). An effective digital marketing approach for MSMEs must consider several aspects: (1) the selection of a platform that suits the target market; (2) creating interesting and relevant content; (3) consistency in communication; (4) the use of analytical data for decision-making; (5) integration between online and offline marketing; and (6) good customer relationship management. The design of product marketing applications based on local wisdom is expected to reduce operational costs and product promotion, thereby increasing profit margins (Salahuddin, 2021). Data-driven marketing strategies allow MSMEs to optimize marketing strategies and risk management (Hendra, 2019; Panggabean *et al.*, 2024).

Local Economy and Local Economic Strengthening

Local economy refers to economic activities that occur within a specific geographic area, which involves the production, distribution, and consumption of goods and services by local communities. MSMEs are a vital component in the local economy because of their ability to create jobs, drive the economy, and utilize local potential. In the context of the city of Medan, MSMEs play an important role in driving the local economy through the production of various regional superior products and the absorption of local labor. Strengthening the local economy is a systematic effort to increase the economic capacity of a region to be more productive, inclusive, and sustainable. Strengthening the local economy can be done through various strategies, including empowering MSMEs, developing local potential, increasing market access, facilitating access to capital, and strengthening local economic institutions. Highly competitive MSMEs will make a significant contribution to local economic growth, job creation, and improvement of community welfare. The digitalization of MSMEs has great potential in strengthening the local economy. Through digital platforms, MSMEs can expand the market from local to regional and even national, increase product added value, and access resources that were previously difficult to reach. Research in Manado City shows that MSMEs play a central role in accelerating regional development (Soegoto *et al.*, 2020). The digital cooperative model as a solution for the collective empowerment of MSMEs can overcome capital constraints and expand the market (Sugina *et al.*, 2024). This approach can be applied in the city of Medan to strengthen the local economy in a sustainable manner.

Theoretical Framework
DeLone and McLean models

The DeLone and McLean Information Systems Success Model is one of the most widely used theoretical frameworks for analyzing the success of information system implementation. This model identifies six dimensions of information system success: system quality, information quality, service quality, use, user satisfaction, and net benefits (Soegoto *et al.*,

2019). In the context of the digitalization of MSMEs, the DeLone and McLean models can be adapted to analyze the success of digital technology adoption. System quality refers to the characteristics of the digital platform used (ease of use, reliability, speed). The quality of information has to do with the accuracy, relevance, and timeliness of the information generated. The quality of service includes technical support and the responsiveness of the service provider. This model has been successfully used to analyze variables that correlate with increased MSME profits (Soegoto *et al.*, 2019). This study will adapt the DeLone and McLean models combined with Structural Equation Modeling to analyze relevant variables that correlate with increased MSME profits.

Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) developed by Davis (1989) is one of the most widely used models to explain the acceptance and use of technology by users. This model focuses on two main constructs: perceived usefulness and perceived ease of use. Perceived usefulness is a person's level of confidence that using a certain technology will improve their job performance, while perceived ease of use is a person's level of confidence that using a certain technology will be effort-free. In the context of MSMEs, TAM can explain the factors that affect the intention of business actors to adopt digital technology. Research shows that perceived ease of use and perceived usefulness have a significant effect on the intention to adopt digital technology (Sengaji & Radiansyah, 2022). If MSME actors perceive that digital technology is easy to use and provides benefits to their business, then they will be more likely to adopt and use the technology in a sustainable manner.

Resource-Based View (RBV)

The Resource-Based View (RBV) is a strategic perspective that emphasizes the importance of a company's internal resources as the basis for achieving a competitive advantage. According to RBV, sustainable competitive advantage can be achieved when a company has resources that are valuable, rare, inimitable, and non-substitutable. In the context of MSMEs,

important internal resources include digital literacy, innovation skills, social capital, and managerial skills. The SEM approach used in this study shows that entrepreneurial orientation acts as a moderation variable that strengthens the influence of digital literacy on technology adoption. These findings are in line with the resource-based view framework, which emphasizes the importance of internal capabilities to achieve competitive advantage (Vrontis *et al.*, 2022). Digital orientation and digital capability also affect business innovation and MSME performance (Khin & Ho, 2018; Nayak *et al.*, 2025), which shows that digital capabilities are an important strategic resource for MSMEs in the digital era.

Diffusion of Innovation Theory

The Diffusion of Innovation Theory developed by Everett Rogers explains how, why, and at what extent new innovations (such as ideas, practices, or technologies) spread in social systems. This theory identifies five characteristics of innovation that affect the rate of adoption: relative advantage, compatibility, complexity, trialability, and observability. This theory also categorizes adopters into five groups: innovators, early adopters, early majority, late majority, and laggards. In the context of MSME digitalization, the theory of innovation diffusion can explain how digital technology spreads among MSME actors. MSMEs that perceive that digital technology has advantages over conventional methods, according to their business values and needs, are not too complex to use, can be tried with low risk, and the positive results can be observed by other business actors, will be faster to adopt digital technology. The role of opinion leaders and change agents is also important in accelerating the diffusion of digital technology among MSMEs.

Research Methodology

This study uses a quantitative approach with a survey method to obtain relevant empirical data on the factors determining the success of digital-based MSME empowerment in Medan City. A quantitative approach was chosen because it allows for objective and measurable

testing of causal relationships between variables. Primary data was collected through structured questionnaires distributed to MSME actors in various business sectors in Medan City. The questionnaire was designed to measure key variables, such as digital literacy, technology adoption, digital marketing strategies, policy support, and SME business performance (Patria *et al.*, 2023). The research sample was determined using purposive sampling, with the criteria for respondents being SME operators who have been in operation for at least two years and have the potential to apply digital technology in their business processes. The sample size will be adjusted according to the complexity of the model and the guidelines for Partial Least Squares Structural Equation Modeling (PLS-SEM) analysis, which is generally adequate even with a relatively small sample size (Afthanorhan *et al.*, 2021). The data obtained will be analyzed using Structural Equation Modeling (SEM) based on PLS-SEM, which was chosen for its ability to handle models with many latent variables, mediation relationships, and complex moderation effects (Vrontis *et al.*, 2022).

This SEM approach enables the identification and testing of causal relationships between variables such as digital facility ownership, technology access capabilities, and digital media use by SMEs (Islami *et al.*, 2021). Additionally, this method allows for the exploration of opportunities to use social media and the internet as tools to support the productive sustainability of SME businesses. The conceptual framework of the study integrates findings from previous studies, such as the influence of perceived ease of use and perceived usefulness on the intention to adopt digital technology (Sengaji & Radiansyah, 2022), as well as the role of digital orientation and digital capabilities on business innovation and SME performance (Khin & Ho, 2018; Nayak *et al.*, 2025). This study also examines the mediating role of certain variables, such as the adoption of green innovations and technologies related to the digital economy and business creativity (Liang *et al.*, 2025), as well as the role of brand equity and consumer trust in enhancing SME profitability (Soegoto *et al.*, 2019).

Path analysis will be used to elucidate the direct and indirect influence mechanisms between variables. Model evaluation includes testing convergent and discriminant validity to ensure construct validity, as well as composite reliability testing to ensure measurement consistency (Desembrianita *et al.*, 2023). This study is expected to provide a comprehensive understanding of the drivers and barriers to SME digitalization, while formulating contextual policy recommendations to strengthen the local economy of Medan City sustainably (Helmalia & Afrinawati, 2018). Structural Equation Modeling (SEM) is a multivariate statistical analysis technique that combines factor analysis and path analysis to test the causal relationship between latent variables and observed variables. SEM allows researchers to identify and test complex cause-and-effect relationships between multiple variables simultaneously, including direct and indirect relationships, as well as mediation and moderation effects. In this study, Partial Least Squares Structural Equation Modeling (PLS-SEM) was used as the analysis method. PLS-SEM was chosen for its ability to handle models with many latent variables, mediating relationships, and complex moderation effects (Vrontis *et al.*, 2022).

PLS-SEM also has advantages in terms of the flexibility of data distribution assumptions and can work well on relatively small sample sizes (Afthanorhan *et al.*, 2021). This method is suitable for exploratory and predictive research, where the main objective is to identify key variables that affect certain phenomena. The SEM approach in this study allows the identification and testing of causal relationships between variables such as digital literacy, digital infrastructure, policy support, technology adoption, digital marketing strategies, and MSME performance. The conceptual framework of the research integrates findings from previous research, such as the influence of perceived ease of use and perceived usefulness on digital technology adoption intentions (Sengaji & Radiansyah, 2022), as well as the role of digital orientation and digital capabilities on business innovation and MSME performance (Khin & Ho, 2018; Nayak *et al.*, 2025). Path analysis will be used to explain the

mechanism of direct and indirect influence between variables. Model evaluation includes testing convergent and discriminant validity to ensure construct validity, as well as composite reliability testing to ensure measurement consistency (Desembrianita *et al.*, 2023). This research is expected to provide a comprehensive understanding of the drivers and obstacles to the digitalization of MSMEs, as well as formulate contextual policy recommendations to strengthen the local economy of Medan City in a sustainable manner (Helmalia & Afrinawati, 2018).
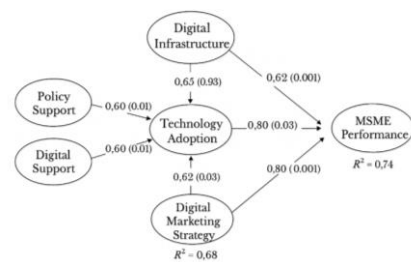

Figure 1. Structural Equation Modeling (SEM) Diagram

Results and Discussion

Results

Quantitative data analysis was conducted using Partial Least Squares–Structural Equation Modeling (PLS-SEM) on a sample of MSME actors in Medan City. Respondents were selected based on the criteria that MSMEs had been operating for at least two years and had the potential for digitization. The conceptual model tested six latent variables: digital literacy (LD), digital infrastructure (ID), policy support (DK), technology adoption (AT), digital marketing strategy (SPD), and SME performance (KU). The structural model evaluation revealed that:

1) The R^2 value for TA = 0.68 and R^2 for MP = 0.74, meaning that 68% of the variability in technology adoption can be explained by DL, DI, and PS; while 74% of the variability in SME performance is explained by TA and DMS.

2) The construct validity and reliability tests show AVE > 0.5 and Composite Reliability > 0.7, thus meeting the convergent and discriminant criteria (Desembrianita *et al.*, 2023).

Path Coefficients, The results of the path coefficient estimation and the significance of the influence between variables are as follows:
1) LD → AT: 0,65 (p < 0,001)
2) ID → AT: 0,58 (p < 0,01)
3) DK → AT: 0,60 (p < 0,01)
4) AT → SPD: 0,62 (p < 0,03)
5) AT → KU: 0,72 (p < 0,001)
6) SPD → KU: 0,80 (p < 0,001)

All pathways have a significant impact, both directly and indirectly. These findings confirm the hypothesis that digital literacy, policy support, and technological infrastructure are the main determinants of successful digital adoption by MSMEs. The SPD variable is the dominant factor that directly influences MSME performance. Comparison with Previous Research. The results of this study are consistent with a number of previous studies:
1) Wijaya & Nailufaroh (2022) found that digital literacy moderates the impact of digitalization on MSME income. This study expands on their findings by directly measuring the influence of LD on AT and SPD.
2) Falentina *et al.* (2020) showed that internet use contributes to MSME productivity. This study supports these results and adds policy support as a significant factor.
3) Sipayung (2025) stated that digital infrastructure and innovation ecosystems drive the operational effectiveness of SMEs. The results of this study align with this, with ID significantly influencing AT (0.58; p < 0.01).
4) Soegoto *et al.* (2019) identified that transaction digitization increases SME profitability. This study reinforces these findings, with SPD having a very dominant effect on KU (0.80; p < 0.001).
5) Rahmi & Yuzaria (2021) emphasize the importance of government support. This study validates with empirical evidence that DK → AT is significant.

However, the differences between this study and previous studies are:
1) This model integrates policy support, digital literacy, and infrastructure variables simultaneously.
2) This study also highlights the impact of

SPD as a key mediating variable bridging technology adoption and SME performance.

Research Implications, The research findings have theoretical and practical implications:
1) Theoretical: Supports DeLone & McLean's model regarding system quality and its impact on performance.
2) Practical: Emphasizes the need for digital literacy training, infrastructure strengthening, fiscal/non-fiscal support, and cross-sector collaboration (government, universities, and e-commerce platforms).

The main challenges identified are capital constraints, digital skill gaps, and data security concerns (Lubis, 2024). Therefore, empowerment programs should focus on continuous mentoring and access to financial technology. This study demonstrates that digital literacy, policy support, and digital infrastructure significantly influence technology adoption, which in turn enhances digital marketing strategies and the performance of MSMEs in Medan City. Digital marketing strategies are the most dominant variable in improving MSME performance. Comparison with previous studies shows that these results reinforce previous theories and provide an updated model with policy and infrastructure variables.

Factors Affecting the Adoption of Digital Technology by MSMEs in Medan
This study found that the adoption of digital technology by SMEs is influenced by various internal and external factors. Internal factors include digital literacy, knowledge of digital marketing, technological readiness, leadership support, and business owner demographics such as age, education, and experience (Putong, 2023; Siregar, n.d.). Business owners with good digital literacy are more prepared to adopt technology and understand the strategic benefits of digitalization. Additionally, psychological factors such as resistance to change and the influence of social networks also affect technology adoption. Some SMEs still have concerns about cybersecurity and lack confidence in new technologies (Karunia *et al.*, 2021; Lubis, 2024). External factors include government policy support, digital

infrastructure, market competition, and training and mentoring programs. Local government policies and private initiatives, such as seminars, workshops, and digital marketing training, have proven to accelerate digital penetration among SMEs (Widyo *et al.*, 2023; Aprilia *et al.*, 2025). The SEM approach used in this study shows that entrepreneurial orientation also acts as a moderating variable that strengthens the influence of digital literacy on technology adoption. This finding is in line with the resource-based view framework, which emphasizes the importance of internal capabilities to achieve competitive advantage (Vrontis *et al.*, 2022).

SWOT of Digitalization of MSMEs in Medan City

SWOT analysis was conducted to examine the internal and external conditions of MSMEs in Medan City in facing the digital era:

1) Strengths: Local product innovation capacity, adaptive human resource quality, and MSME flexibility in responding to market trends. SMEs in Medan have the potential to produce locally-based products that can be marketed through digital platforms (Chandrayanti, 2022).
2) Weaknesses: Low digital literacy, limited capital, limited technological infrastructure, and lack of technical skills in digital marketing (Putong, 2023; Munandar *et al.*, 2025). Most SMEs still rely on traditional marketing, so they don't really use social media and marketplaces.
3) Opportunities: Increased internet penetration in Indonesia, government support for SME digitalization, and consumer trends that are increasingly relying on e-commerce (Sipayung, 2025; Anita, 2022). Government programs such as payment digitalization and facilitating access to e-commerce platforms present significant opportunities to expand the market.
4) Threats: Intense market competition, data and cybersecurity issues, and reliance on specific technology platforms. Another challenge is inconsistent digital regulations and the risk of digital inequality between SMEs that have gone digital and those that remain conventional (Siregar, n.d.).

This SWOT analysis underscores the importance of cross-sector collaboration between government, private sector, and community to optimize strengths and opportunities while anticipating weaknesses and threats.

Effective Digital Empowerment Strategies for MSMEs in Medan

This study recommends effective digital empowerment strategies that are appropriate for the context of MSMEs in Medan City. These strategies include:

1) Digital literacy and online marketing training programs that are relevant to the needs of MSMEs. The material covers the use of marketplaces, social media marketing, and digital financial management (Wijaya & Nailufaroh, 2022).
2) Development of digital infrastructure and access to financial technology (fintech). The implementation of the Indonesian Standard Quick Response Code (QRIS) has proven to expand sales reach, facilitate transaction recording, and support financial inclusion (Anggarini, 2022; Sari & Adinugraha, 2022).
3) Strategic partnerships with e-commerce platforms and financial institutions. This collaboration opens up opportunities for digital financing and expands market access for SMEs (Erlanitasari *et al.*, 2020).
4) Product diversification and data-driven innovation. The use of predictive analytics from sales data can enhance marketing strategies and risk management (Hendra, 2019; Panggabean *et al.*, 2024).
5) Digital cooperative models as a solution for collective empowerment of SMEs to overcome capital constraints and expand markets (Sugina *et al.*, 2024).

These strategies must be accompanied by fiscal and non-fiscal policies that favor SMEs, such as tax incentives and digitalization assistance. This aligns with the global trend that digitalization of payments and marketing is key to the competitiveness of SMEs in the modern economy (Anggarini, 2022). This discussion shows that the success of SME digitalization in Medan City is influenced by internal factors (digital literacy, entrepreneurial orientation, marketing knowledge) and external factors

(infrastructure, government policies, market competition). The SWOT analysis reveals that despite weaknesses and threats, opportunities and strengths can be optimized through targeted digital empowerment strategies. The research recommendations emphasize the importance of digital literacy training, strategic partnerships, and policies that support an inclusive digital ecosystem.

Discussion

The findings of this study reveal that digital literacy, technological infrastructure, and policy support play significant roles in driving technology adoption among MSMEs in Medan. This aligns with the work of Wijaya and Nailufaroh (2022), who emphasize digital literacy as a critical moderating factor enhancing MSME income through digitalization. Furthermore, the significant impact of digital infrastructure on technology adoption corroborates Sipayung's (2025) findings, which highlight the importance of technology readiness and innovation ecosystems in improving MSME operational effectiveness. Policy support involving fiscal incentives and digital training echoes the conclusions of Rahmi and Yuzaria (2021), underscoring the government's role in fostering an enabling environment for MSME digital transformation. Moreover, digital marketing strategy emerges as the most influential variable affecting MSME performance, reinforcing Soegoto *et al.*'s (2019) evidence that digital transaction adoption positively contributes to MSME profitability. This is consistent with Apriani *et al.* (2023), who found that digital marketing utilization was pivotal in sustaining MSMEs during the pandemic. Nonetheless, challenges such as capital constraints, digital skills gaps, and cybersecurity concerns remain significant barriers, as noted by Lubis (2024). Therefore, effective empowerment programs must integrate continuous digital literacy training, infrastructure enhancement, and cross-sector collaboration to facilitate greater access to technology and digital finance. Conceptually, these results support the Resource-Based View (RBV) framework, which stresses the importance of internal resources such as digital literacy and entrepreneurial orientation in building competitive advantage

(Vrontis *et al.*, 2022). The use of SEM-PLS methodology enables simultaneous examination of causal relationships among variables, enhancing the robustness of a model that combines technical and policy factors. Overall, this study provides empirical evidence to inform the development of adaptive and sustainable digital empowerment strategies tailored to the specific business environment of Medan.

Conclusion

This study confirms that the adoption of the Quick Response Code Indonesian Standard (QRIS) is a key driver accelerating MSME digitalization in Indonesia, including Medan. QRIS implementation facilitates cashless transactions, broadens market reach, enhances operational efficiency, and promotes financial inclusion for micro, small, and medium enterprises. Widespread QRIS adoption enables MSMEs to respond more swiftly to the evolving digital market, contributing significantly to both local and national economic recovery. The success of this initiative depends largely on digital and financial literacy among MSME operators, the availability of supporting infrastructure, and the effectiveness of educational outreach by Bank Indonesia and digital payment providers. Adaptive regulations and collaboration among local governments, financial institutions, and MSME associations are crucial to establishing an inclusive and sustainable digital ecosystem. Furthermore, integrating financial technology (fintech) with QRIS supports MSME sustainability by facilitating access to financing, cash flow management, and data-driven digital marketing strategies, thereby enhancing competitiveness in the digital economy. Using Structural Equation Modeling (SEM), the study demonstrates that digital and financial literacy significantly influence QRIS adoption and fintech utilization. Empowerment strategies focused on digital training and policy support mediate the success of MSME digital transformation. However, barriers such as low awareness, limited internet access, and cybersecurity concerns persist, necessitating risk mitigation through strengthened data

protection, improved digital security literacy, and expanded network infrastructure. In summary, QRIS and fintech present substantial opportunities to accelerate MSME digital transformation. Policy recommendations include implementing sustainable digital and financial literacy programs, fostering collaboration among government, financial institutions, and digital platforms to widen technology and financing access, enacting adaptive regulations and incentives to promote QRIS adoption, and enhancing technological infrastructure to ensure equitable internet and cashless transaction access across regions. These strategies will better integrate MSMEs into the digital economy and support Indonesia's ambition to become Southeast Asia's largest digital economy in the near future.

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