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QR Code Payment Acceptance and Its Impact on SMEs Sustainability Performance

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Abstract: The diffusion of contactless payment technologies has become a critical component of digital transformation strategies aimed at enhancing SME competitiveness in developing economies. Among these technologies, Quick Response (QR) Code Payment offers a low-cost and infrastructure-light solution, yet its adoption among SMEs remains uneven. This study investigates the determinants of QR Code Payment adoption and its subsequent effects on SMEs' sustainability performance. Anchored in the Technology Acceptance Model (TAM) and the Resource-Based View (RBV), the proposed framework incorporates perceived usefulness, perceived ease of use, digital literacy, QR Code Payment adoption, and sustainability performance as core constructs. Integrating TAM and RBV is essential because belief-based perceptions translate into actual adoption only when supported by adequate organizational resources and capabilities, making adoption decisions the product of an interaction between what users believe and what the firm is able to execute. Survey data from 326 SMEs in the Special Region of Yogyakarta, Indonesia, were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The results demonstrate that perceived usefulness and digital literacy significantly drive QR Code Payment adoption, whereas perceived ease of use does not, suggesting that performance-oriented beliefs and capability endowments outweigh perceptions of simplicity in shaping adoption behavior. Furthermore, QR Code Payment adoption positively influences economic, social, and environmental aspects of sustainability performance. These findings highlight the strategic value of digital payment integration for advancing SME sustainability and underscore the need to strengthen digital capabilities to accelerate technological uptake. The study extends the literature by jointly applying TAM and RBV to elucidate how belief structures and firm-level capabilities interact to shape adoption outcomes and their performance implications within resource-constrained contexts. For ecosystem coordinators, aligning merchant education with simple analytics dashboards can help SMEs turn payment data into insights—underscoring the need for policy support from government, financial institutions, and payment providers to ensure QR payment adoption translates into real performance gains.

Keywords: QR code payment; Digital literacy; Sustainability performance; SMEs

JEL Classification: G23, L25, O33, D14

1. Introduction

Financial technology (FinTech)—the integration of information technology (IT) with existing financial services—delivers innovative modes of service provision that are more efficient, user-friendly, and secure. In this study, FinTech is understood as a set of digitally enabled processes that redesign how payments, transfers, and related financial interactions are initiated, authorized, and settled, thereby reducing friction in day-to-day

transactions. Among these offerings, e-wallets or mobile payments have drawn substantial attention in consumer retail (Hamzah et al., 2023). Recent advances in payment technology have enabled transactions that are no longer fully dependent on cash or credit/debit cards, supported by a growing array of digital payment options (de Luna et al., 2019; Yu et al., 2022). Mobile payment (m-payment) allows product and service purchases via smartphones and confers direct benefits to both consumers and merchants—such as faster checkout, reduced handling of physical cash, and streamlined recordkeeping (Chawla & Joshi, 2019; Spinelli et al., 2024). With mobile markets expanding, online banking and online purchases can be conducted on handheld devices (Zhong & Moon, 2022), and the ubiquity of app-based interfaces further lowers entry barriers for routine use by individuals and small firms alike (Zhong & Moon, 2022).

Worldwide shifts toward digital payments have reshaped SME business activities. A prominent innovation is the use of Quick Response (QR) Code payments, valued for speed, convenience, and efficiency (Tu et al., 2020). QR Code payment is part of a Mobile Payment System (MPS) underpinned by Near Field Communication (NFC), employing scannable QR codes and reading devices. The QR code itself—developed by Denso Wave—is a two-dimensional symbol readable by dedicated scanners and modern smartphones (Hewage et al., 2024; Liébana-Cabanillas et al., 2015). Its distinctive capacity to carry varied digital content makes it a versatile conduit for product information—ranging from customer reviews to stock availability, prices, and promotional offers (Aurazo & Gasmi, 2024; Sang Ryu & Murdock, 2013). Since Indonesian central bank launched standardized QR Code Payment in 2019, it has served as a strategic instrument to expand financial inclusion, catalyze SME digital transformation, and accelerate growth in Indonesia's digital economy (Putri et al., 2023); the standardization effort also promotes interoperability across providers and consistent user experiences (Putri et al., 2023).

QR Code Payment has grown rapidly in Indonesia, with its adoption exceeding 52 million users and 33 million merchants in 2024—over 90% of whom are SMEs—while annual transaction values have surpassed Rp240 trillion. Although this expansion signals strong momentum toward a cashless economy, existing research remains limited in explaining why SMEs adopt QR-based payments and how such adoption affects their business performance. Despite widening use, many SMEs have not integrated QR codes optimally. In increasingly complex business conditions, this technology should bolster resilience and support progress toward enterprise sustainability (Yan et al., 2021). In practice, however, adoption often stops at basic point-of-sale acceptance, leaving more advanced features—such as dynamic links to inventory status or tailored post-purchase engagement—underutilized. A key advantage of QR codes is their flexibility to embed and update information without altering the symbol's structure, enabling timely, contextual delivery of relevant product content (Alam et al., 2024; von Briel, 2018). This flexibility allows SMEs to align messaging with demand fluctuations, seasonal campaigns, and service updates while preserving low deployment costs (Alam et al., 2024; von Briel, 2018).

Even as QR code adoption has surged, the academic literature remains comparatively thin. A sizable gap persists between current market dynamics and a scholarly record on mobile payment systems that is largely outdated (Wang et al., 2024). Few studies focus specifically on QR code use in physical stores, the technology's resurgence in retail practice, or applications to high-involvement products such as consumer electronics. Consequently, contemporary research on why consumers use, respond to, or reject QR code interactions is increasingly necessary (Kjeldsen et al., 2023). Such inquiry is particularly important because acceptance drivers may vary by context—store layout, product category, and perceived risk—factors not fully captured in earlier, more general payment studies (Kjeldsen et al., 2023).

Although more than 96% of Indonesian enterprises are SMEs, fewer than 20% have adopted digital technologies (including QR Code Payment). Relative to other ASEAN countries (Thailand 71%, Vietnam 43%), Indonesia's SME adoption remains low. Financial and digital literacy are persistent barriers to the uptake of digital payments among Indonesian SMEs (Sutrisno & Nainggolan, 2025). Few studies have examined QR Code Payment adoption by Indonesian SMEs or its effects on sustainability performance (economic, social, environmental). Prior work has largely considered adoption in general terms or from the consumer's perspective, not from SMEs or with a sustainability lens (Irianto & Chanvarasuth, 2025). At the same time, Indonesia is promoting a cashless economy and SME digitalization, making findings from this research strategically relevant for industry and policymakers who must calibrate interventions to local capability constraints and sectoral needs.

To date, most literature on payment-technology adoption (Jiddah et al., 2025; Liébana-Cabanillas et al., 2015; Suo et al., 2022) has not explicitly linked QR code technologies to SME sustainability performance (Hall et al., 2010; Ledi et al., 2023), especially in Indonesia. Studies on digital payments (e.g., mobile payment, internet banking) typically emphasize intention or adoption from consumer perspectives in developed economies (Türker et al., 2022). There is limited investigation of QR Code Payment acceptance from the viewpoint of Indonesian SMEs, particularly regarding impacts on sustainability outcomes. Moreover, no study has integrated TAM with Trust and Government Support to explain how acceptance affects Sustainability Performance across economic, social, and environmental dimensions. Addressing this gap can clarify whether belief-based determinants of use coincide with institutional enablers, thereby illuminating complementary pathways through which QR payment acceptance may influence longer-term performance.

Although QR Code Payment is now integral to Indonesia's payment digitalization, SME acceptance remains

low due to limited digital literacy, insufficient trust, and weak appreciation of long-term sustainability implications. This creates a need for research that integrates digital-technology adoption with its consequences for SME sustainability performance across economic, social, and environmental pillars (Maziliauske, 2024). In practical terms, an integrated approach can help identify which capability-building efforts, trust assurances, and policy supports are most likely to translate adoption into durable gains for small businesses (Maziliauske, 2024).

Accordingly, this study advances critical arguments concerning Perceived Ease of Use (PEOU), Perceived Usefulness (PU), and Technology Use in the context of QR Code Payment adoption and its effects on SME sustainability performance. Here, PEOU captures users' judgments about the effort required to operate QR-based systems, PU reflects anticipated performance gains from such use, and Technology Use denotes the extent to which QR-enabled payments are actually deployed in routine transactions and related workflows. The argument is developed through analysis of QR Code Payment implementation in the SME sector, integrating an extended Technology Acceptance Model (TAM) with digital literacy and grounding the framework in the Resource-Based View (RBV). In this integrated view, belief-driven acceptance (PEOU and PU) is linked to capability-based readiness (digital literacy), clarifying how perceptions are converted into consistent usage and, in turn, into sustainability-oriented outcomes. Adoption of QR-based payment is positioned as a response to Industry 4.0—an era marked by rapid diffusion of innovation, heightened connectivity, and ongoing process reconfiguration—where organizational agility and resource alignment become central. Given limitations in prior research and the heightened relevance of contactless payments, this study seeks to enrich the literature and elucidate drivers of QR Code Payment use in developing countries while offering insights for nations with similar conditions, particularly those where resource constraints and heterogeneous market readiness shape the pace and depth of digital transformation. In doing so, the framework highlights specific leverage points—usability perception, benefit communication, and literacy building—through which policy makers and providers can foster adoption that supports sustained economic, social, and environmental performance.

2. Literature Review and Hypothesis Development

2.1 TAM and RBV

Two theoretical approaches widely used in technology-adoption research are TAM and RBV. These perspectives are complementary: TAM centers on end-user acceptance, whereas RBV foregrounds an organization's internal capabilities (Ayyash & Salah, 2025; Yu et al., 2025). By integrating TAM and RBV, this study not only identifies the factors shaping QR Code Payment acceptance among SMEs but also delineates the role of internal capabilities—such as digital literacy and the degree of QR Code Payment adoption—as strategic assets that can drive sustainability performance across economic, social, and environmental dimensions. In practical terms, the integrated lens links what users believe about a system with what the firm can actually mobilize to support effective use, aligning front-end perceptions with back-end readiness and clarifying where managerial interventions should focus (Ayyash & Salah, 2025; Yu et al., 2025). TAM represents a pivotal development in information systems by adapting core acceptance constructs to a technology-use context, thereby translating general attitudinal principles into variables that are directly observable in IT settings. Within TAM, individuals' adoption decisions are primarily influenced by PU and PEOU (Wei et al., 2025). These beliefs shape attitudes toward the system and inform intention formation, creating a parsimonious pathway from cognition to behavior that is especially relevant for routine, high-frequency payment activities where small frictions can materially alter usage (Wei et al., 2025).

TAM is well suited to explain QR Code Payment acceptance among SME actors because it captures how perceptions of system ease and utility shape usage intention. Since its introduction in 1989, TAM has evolved into one of the most widely employed theoretical frameworks in Information Systems (IS), explicating links among beliefs, user attitudes, behavioral intention, and actual system use. Conceptually, TAM offers a robust lens for understanding technology adoption processes (Putri et al., 2023). In this framework, perceived ease of use is posited to influence perceived usefulness; in turn, behavioral intention is shaped by user attitudes and perceived usefulness and ultimately predicts actual system use (Natasia et al., 2022). For SMEs, where decision cycles are short and resources constrained, this causal chain is particularly salient: incremental improvements in perceived simplicity can elevate assessments of utility, which then convert into stronger intentions and, ultimately, more consistent usage in daily transactions (Natasia et al., 2022).

Digital transformation has become critical to organizational success, particularly for small and medium enterprises (SMEs). In this context, a nuanced understanding of factors that affect adoption and the effectiveness of technology implementation is essential in contemporary business and organizational settings (Clemente-Almendros et al., 2024). Originally conceived to explain how individuals perceive and accept new technologies, TAM highlights two core belief constructs—PU and PEOU—which reflect users' confidence in a technology's performance benefits and their assessment of its ease of use (Saif et al., 2024). When applied to QR Code Payment, these beliefs capture the perceived gains in transactional efficiency and the clarity of interaction steps (e.g.,

scanning and confirmation), both of which can lower cognitive effort and reduce uncertainty during payment (Saif et al., 2024). Consequently, TAM provides an actionable diagnostic for isolating which perceptions most hinder or facilitate adoption among SME stakeholders, guiding interventions such as interface simplification or onboarding support (Saif et al., 2024).

From an RBV standpoint, digital capabilities—including the capacity to adopt QR Code Payment—constitute strategic resources. Digital literacy and knowledge adoption function as internal resources that mediate or facilitate the attainment of sustainability performance. RBV explains how adoption contributes to sustainable outcomes by originating in internal capability (Barney, 1991). The RBV emphasizes that an organization's social complexity, including interpersonal interactions, can generate unique, hard-to-imitate resources. Its central focus is the strategic management of internal resources to identify and leverage capabilities, assets, and core competencies as sources of long-term competitive advantage (Pickles et al., 2025). This perspective maintains that a firm's advantage hinges on its ability to manage internal resources with VRIN characteristics (Valuable, Rare, Inimitable, and Non-substitutable). In technology adoption, RBV underscores that information technologies or digital systems will not yield strategic value absent supporting internal resources such as human-capital competencies, IT infrastructure, and organizational culture; consequently, RBV is highly pertinent for assessing an organization's readiness to exploit technology fully (Llach et al., 2025). Under this view, QR Code Payment becomes strategically consequential when firms pair the tool with complementary capabilities—training, data integration, and process redesign—that transform mere usage into sustained performance gains and measurable improvements in competitiveness (Llach et al., 2025).

A growing body of adoption studies integrates TAM and RBV in deriving empirical insights. TAM has consistently proven relevant for explaining user behavior toward digital payment systems, as reflected in this study. Although alternative approaches exist, TAM is particularly apt for mobile payment contexts because it accommodates key factors such as ease of use, user satisfaction, and alignment with innovation-diffusion models (Ong et al., 2022). Applying TAM alongside RBV is therefore appropriate for explaining determinants of technology-system adoption, given their complementary emphases on user behavior and internal organizational capabilities (Jiddah et al., 2025). The combined approach clarifies not only whether users are willing to adopt but also whether firms possess the requisite resources to sustain and scale that adoption; in doing so, it links micro-level acceptance mechanisms to meso-level capability development and, ultimately, to measurable improvements in sustainability performance through more reliable, repeatable, and value-generating use over time.

2.2 Relationship Between PU and QR Code Payment Adoption

Perceived usefulness denotes the extent to which individuals believe that using a technology will enhance effectiveness or productivity in their work (Davis, 1989). In other words, it is an instrumental belief about performance gains that users expect to realize when the system is actually employed in task execution, capturing anticipated improvements in speed, accuracy, or overall output quality (Davis, 1989). As Robey (1979) argues, a technological system will not be positively received if it fails to deliver tangible performance gains, regardless of its other features; perceived benefit is therefore pivotal in shaping acceptance of a system. Put differently, even sophisticated functionality or appealing interfaces are unlikely to sway adoption decisions if users do not anticipate concrete improvements in output quality, speed, or efficiency, meaning that subjective benefit expectations act as a gatekeeper to subsequent intention formation (Robey, 1979).

Rogers et al. (1996) further contend that PU reflects the degree to which users believe a new technology affords higher effectiveness than prior systems. Building on this comparative logic, PU captures users' judgments that a given solution will outperform existing routines or payment methods in delivering desired outcomes and, hence, merits incorporation into everyday workflows (Rogers et al., 1996). Prior studies indicate that this perception significantly influences adoption of QR Code–based payment systems. Liu et al. (2025) explains that PU directly affects Intention to Use Mobile Payment, and users will employ a payment system when they regard it as useful for their transactional needs or financial problems, underscoring the salience of perceived problem-solving capacity in payment contexts (Kim et al., 2010). Consistent with the TAM, Perceived Usefulness plays a central role in encouraging intention to use digital payment systems by shaping attitudes and intention formation, thereby providing a proximal cognitive mechanism that links evaluations of benefit to concrete behavioral plans (Benbasat & Wang, 2005; Tung et al., 2008).

Empirical evidence reinforces this relationships. Türker et al. (2022) show that PU significantly influences the implementation of QR code mobile payment systems in Turkey. Comparable relationships have been documented across multiple domains, including Mobile Payment (Abdullah & Naved Khan, 2021; Liébana-Cabanillas et al., 2015), E-commerce (Gefen et al., 2003), massive open online course (Daneji et al., 2019), Travel 2.0 Websites (Muñoz-Leiva et al., 2012), Internet-based Learning System (ILS) (Saadé & Bahli, 2005), E-wallets in Vietnam (Truc, 2024), QR Code (Bashir, 2022), QR Code-enabled Mobile Payment Systems (Yamin & Abdalatif, 2024), and Blockchain Technology (Khan et al., 2025). Taken together, these findings suggest that when users perceive clear performance advantages—such as faster processing, reduced effort, or better problem solving—they are more

inclined to intend to use and subsequently adopt the technology, with PU serving as a consistent predictor across varied application domains and user groups. Based on the foregoing, we advance the following hypothesis:

H1: Perceived usefulness is related to QR code payment adoption.

2.3 Relationship Between PEOU and QR Code Payment Adoption

PEOU refers to the extent to which individuals judge a system to require minimal effort or be straightforward to operate, and it has been identified as a primary determinant of new-technology adoption (Davis, 1989). In practical terms, PEOU reflects users' expectations about the clarity of the interface, the simplicity of the steps required, and the overall reduction in cognitive load when interacting with a system, including attributes such as learnability, memorability, and perceived controllability during routine tasks (Davis, 1989). Its influence may arise through self-efficacy and instrumentality mechanisms that jointly stimulate intentions to use; self-efficacy is also a key component of intrinsic motivation rooted in task approach and execution strategies, thus encouraging continued exploration, error recovery, and eventual routinization. In addition, ease of use shapes usage intention indirectly by enhancing perceived usefulness, because systems that feel simple to operate are more likely to be evaluated as capable of improving performance, thereby strengthening favorable attitudes toward adoption over time (Wang et al., 2003). In the context of QR Code payment adoption, PEOU captures users' perceptions of the simplicity of running the system and following the procedures associated with its use, such as opening the app, scanning the code, verifying the amount, and confirming payment—all of which, when perceived as effortless and reliable, reduce friction at checkout and strengthen the intention to adopt.

Applying TAM, Al-Somali et al. (2009) show that perceived ease of use and perceived usefulness are critical determinants of online banking adoption in Saudi Arabia, underscoring TAM's relevance for financial-service contexts in which trust and usability jointly matter. George (2018) finds that perceived ease of use functions as a pivotal conduit linking service quality to intention/usage levels, indicating that usability perceptions help convert service evaluations into concrete behavioral plans and repeat usage. Moreover, perceived ease of use often emerges as the strongest driver of adoption in financial systems, where users favor methods that minimize steps, errors, and learning costs and where minor usability gains can yield disproportionate increases in uptake (Aldás-Manzano et al., 2009; Alwan & Al-Zubi, 2016). Subsequent work has probed consumers' intentions to use digital payments. Utilizing an extended TAM, Belmonte et al. (2024) investigate specific factors shaping intention to use the E-Wallet GCash in the Philippines, highlighting the salience of ease perceptions in mobile contexts with frequent, low-value transactions and time-sensitive decisions. Across related studies, perceived ease of use is among the most significant predictors of Intention to Use digital payment technologies (Abdennebi, 2023; Chang et al., 2021; Dutot et al., 2019; Malaquias & Silva, 2020; Rahi et al., 2023; Wei et al., 2025). Consistently, Alrawad et al. (2023) report that perceived ease of use and perceived usefulness affect users' intentions to adopt Line Pay, where ease and perceived benefits foster positive attitudes that reinforce intention. At the industry level, widespread digital adoption has reshaped financial workflows, and consumers are increasingly confident conducting online banking via diverse digital platforms—a trend that further elevates the role of PEOU in lowering adoption barriers by simplifying onboarding and day-to-day interaction (Alnemer, 2022). Based on this literature, we posit:

H2: Perceived ease of use is related to QR Code Payment Adoption.

2.4 Relationship Between Digital Literacy and QR Code Payment Adoption

For SMEs to function effectively within the digital ecosystem, digital literacy is critical. In operational terms, digital literacy equips owners and employees to navigate platforms, evaluate alternatives, and troubleshoot basic issues that arise in day-to-day transactions, thus enabling more reliable participation in online markets and payment networks. Beyond basic operation, it also entails the ability to interpret on-screen cues, manage credentials securely, and coordinate among multiple apps or devices during the same transaction flow, all of which reduce downtime and errors in routine commerce. Prior work has examined digital transformation in business more broadly (Zahoor et al., 2023). Santoso et al. (2020) argue that expanding internet penetration and smartphone availability are primary drivers accelerating digital adoption on both the demand and supply sides, which in turn lowers entry barriers for smaller firms. Survey evidence on readiness to use digital financial services in Indonesia indicates that infrastructure quality also shapes firms' preparedness to leverage such services (Affandi et al., 2024). A key component of digital literacy is one's attitude toward technology, reflecting the willingness to explore and adopt new devices and digital solutions—a disposition that influences how quickly users experiment with, learn, and ultimately routinize new tools (Shatila et al., 2025). In aggregate, these factors jointly determine whether SMEs merely access digital channels or actually integrate them into stable, repeatable operating routines (Affandi et al., 2024; Santoso et al., 2020; Shatila et al., 2025; Zahoor et al., 2023).

Digital literacy refers to end users' capabilities within the digital business ecosystem, including their role as prospective consumers. In practice, such capabilities span basic operational skills, critical assessment of digital information, and safe-use practices that reduce perceived risk during transactions. These competencies also

encompass judgment about data sharing and privacy settings, the capacity to recognize suspicious prompts, and the discipline to verify payees or amounts before authorizing payments—behaviors that directly affect confidence and continuity of use. Unlike the relatively settled definition of the digital economy, digital literacy still lacks definitional consistency and standardization; meanings vary across the academic literature and are often tailored to each study's focus and context (Irfan et al., 2022). Wagle (2024) shows that understanding of QR Code and cost considerations exert a significant, positive effect on decisions to adopt QR Code–based payment systems. Higher adoption depends on the extent to which consumers possess knowledge and understanding of the technology, both of which are crucial for building trust in QR Code use. In short, when users know how the system operates and what costs to expect, they are more likely to perceive the process as transparent and manageable, thereby strengthening readiness to adopt. This trust-building function of literacy is especially salient for first-time users who must bridge uncertainty to reach habitual usage (Irfan et al., 2022; Wagle, 2024).

Ly & Ly (2024) find that financial literacy not only influences adoption levels but also mediates the relationship between user attitudes and adoption decisions, while knowledge of infrastructure availability and quality is pivotal in forming customer perceptions. These findings underscore the importance of financial understanding in supporting acceptance of digital payment systems and the need for strategies that bolster consumer trust. Moreover, perceived ease of use partially mediates the relationship between digital literacy and users' intention to adopt digital payment technologies (Ullah et al., 2022). Put differently, literacy enhances ease perceptions, which then translate into stronger intentions to use, indicating a layered pathway from knowledge to adoption (Ullah et al., 2022). In this layered pathway, literacy reduces ambiguity about steps and outcomes, PEOU lowers cognitive effort at the moment of action, and intention consolidates into routine behavior—together producing more stable adoption trajectories over time (Ly & Ly, 2024; Ullah et al., 2022).

Consistent with this view, Kirana & Havidz (2020) report that financial-management ability and digital literacy affect individuals' intentions to adopt mobile payment systems. Recent studies likewise emphasize the strategic role of financial and digital literacy in broadening the use of digital payment technologies (Lo Prete, 2022). In line with this, Nyakurukwa et al. (2025) indicate that education and literacy contribute to more frequent use of digital payment services—particularly peer-to-peer (P2P)—and highlight the salience of social influence in the adoption process. Together, these results suggest that capability building interacts with social cues and peer examples to normalize digital transacting, especially in communities where informal recommendations carry weight. Taken together, this body of work suggests that capability building and positive technology attitudes operate alongside supportive infrastructure to move users from awareness to regular utilization. Based on this literature, we propose the following hypothesis:

H3: Digital literacy is related to QR code payment adoption.

2.5 Relationship Between QR Code Payment Adoption and SMEs' Sustainability Performance

The Quick Response (QR) code—originally developed by Denso Wave in 1994 to track automotive components—has undergone a substantial transformation, particularly in financial transactions, becoming a key driver of mobile-based payment systems (Okazaki et al., 2019). As a two-dimensional machine-readable symbol that can store alphanumeric information and be scanned rapidly by smartphone cameras, the QR code reduces procedural steps at checkout and lowers the need for specialized hardware, thereby simplifying payment flows (Okazaki et al., 2019). By streamlining payment processes, QR codes have reshaped consumer transactions, especially in countries such as China and India, where platforms like WeChat Pay, Alipay, and Paytm pioneered QR code–based payments (Huang & Chueh, 2021; Sleiman et al., 2021). In these markets, code-scanning has normalized everyday payments in both formal retail and small-merchant settings, reinforcing consumer familiarity and merchant acceptance (Huang & Chueh, 2021; Sleiman et al., 2021). Building on these dynamics, QR payments are frequently adopted by micro and small sellers because the onboarding process is low cost, the learning curve is modest, and the transaction experience for customers is intuitive. Cashless transactions now allow consumers to settle payments quickly and conveniently by scanning a code with a smartphone, reducing queues at the point of sale and minimizing cash-handling risks for merchants.

Mobile-device–based payments currently dominate the fintech sector as a primary option for everyday consumer transactions (Ha et al., 2024). For SMEs, the uptake of financial technologies and digital payments has the most pronounced effects on financial performance, while simultaneously improving operational efficiency and revenue growth by shortening settlement cycles and facilitating digital recordkeeping (Nurchayati et al., 2024). These digital trails also support basic analytics—such as sales monitoring and reconciliation—that improve planning and working-capital management. FinTech has also catalyzed new business models—P2P lending, mobile applications, and crowdfunding platforms—that lower financing barriers for SMEs and widen access to working capital (Abbasi et al., 2021). Complementary technologies such as big data enable financial institutions to tailor products to the specific needs of each SME, aligning pricing, risk assessment, and service bundles with firm characteristics (Acciarini et al., 2023). Collectively, these developments position mobile payments as both a transactional tool and an entry point into a broader suite of digital financial services that can support growth trajectories for smaller

enterprises (Ha et al., 2024; Nurchayati et al., 2024).

Recent scholarship calls for deeper, context-sensitive understanding of fintech's effects on SMEs and underscores its growing relevance for sustainability-oriented strategy and practice. In a rapidly evolving economy shaped by technological advances and shifting demand, synergy between public policy and fintech innovation is pivotal for broadening SME financial inclusion and fostering a more inclusive future economy (Abu et al., 2025; Troise et al., 2022). Such synergy can help align innovation incentives with market safeguards, ensure interoperability, and strengthen trust in digital payments—preconditions for durable adoption that vary across regions and sectors (Abu et al., 2025; Troise et al., 2022). In practical terms, this means coupling product innovation with clear standards, risk controls, and accessible literacy initiatives so that adoption scales beyond early users to the wider SME base. Based on this discussion, this study propose:

H4: QR code payment adoption is related to SMEs' sustainability performance.

Accordingly, TAM and RBV are well suited to examine the determinants of QR code–based payment adoption. TAM offers a user-centered lens that explains acceptance through belief structures—most notably PEOU and PU—while RBV emphasizes the internal capabilities and resources that enable firms to deploy and scale technologies effectively. Together, these perspectives provide a complementary account that links what users think and feel about a system to what organizations can actually mobilize to support its successful use. These complementary perspectives are employed to extend understanding by integrating key variables—PEOU, PU, and Digital Literacy—that collectively support sustainability outcomes in the SME sector. In this formulation, PEOU captures users' judgments about the effort required to operate QR-based systems, PU reflects perceived performance gains from their use, and Digital Literacy represents an organizational capability that facilitates effective configuration, training, and routine utilization so that adoption becomes reliable and repeatable. The proposed conceptual framework aligns these elements to clarify how user beliefs interface with firm-specific capabilities, specifying expected links from ease and usefulness perceptions to adoption and, subsequently, to sustainability-oriented benefits in economic, social, and environmental domains. By making explicit the junction between belief formation (TAM) and capability deployment (RBV), the framework also indicates where managerial interventions—such as usability refinement or skills development—are most likely to accelerate uptake and translate usage into performance improvements. The proposed conceptual framework is presented in Figure 1.

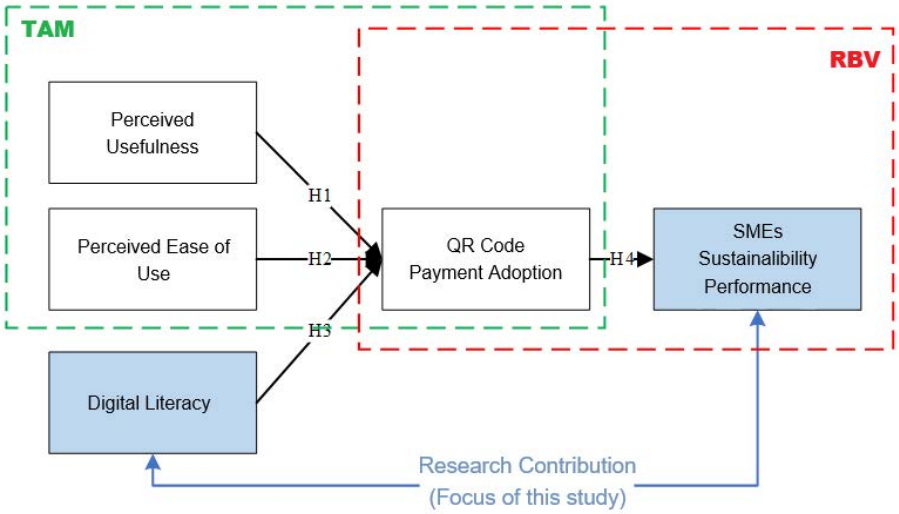

Figure 1. Research framework

3. Methodology

3.1 Population and Sample

This study focuses on SMEs (small and medium enterprises) in Daerah Istimewa Yogyakarta, Indonesia, thereby ensuring a verifiable sampling frame and clear eligibility criteria for inclusion based on officially registered business entities. Yogyakarta is an ideal setting for this study because its vibrant SME landscape and rapidly growing but uneven use of QR Code Payment offer a natural environment to understand how digital payment acceptance can shape SMEs' sustainability performance. Questionnaires were distributed to approximately 4706 respondents, of which 326 were returned and usable for analysis (response rate 6.29%). To ensure adequate coverage and sample representativeness, this study distributed the survey to all SMEs listed in the curated database

maintained by the local government. Average response rates when CEOs are surveyed are typically 5% for large firms, 10% for medium firms, and 14% for small firms (Falconer & Hodgett, 1997). Accordingly, a 6.29% response rate is comparable to executive-survey benchmarks and is reasonable given the decision-making responsibilities and time constraints of SME principals; in effect, the achieved rate falls within the range expected for managerial respondents and is consistent with prior experience in firm-level surveys (Falconer & Hodgett, 1997). The minimum sample size was determined by multiplying the total number of indicators, 18, by 10, yielding a required minimum of 180 (Pallant, 2020). This "10-per-indicator" heuristic provides a conservative threshold for multivariate analyses that rely on multiple observed measures per construct and guards against underspecification in parameter estimation (Pallant, 2020). The final sample of 326 thus exceeds the minimum threshold. Exceeding the requirement increases the precision of estimates, supports more stable parameter recovery, and enhances the robustness of inference for the relationships tested in this study, while also offering a margin of safety against random sampling error and modest levels of item nonresponse.

The study surveyed 326 SME owners in the Special Region of Yogyakarta (see Table 1). Most respondents were female (62.6%), and a substantial proportion held higher education qualifications, with 43.3% completing a bachelor's degree and 33.7% finishing senior high school. The sample also represented a diverse set of business sectors, dominated by culinary enterprises (51.5%), followed by fashion (16.0%) and trade (12.3%). This distribution reflects the typical demographic and industrial composition of SMEs in the region, providing a representative basis for analyzing QR Code Payment adoption.

Table 1. Characteristics of respondents

Category	Sub-Category	Number	Percentage
Gender	Male	122	37.4%
	Female	204	62.6%
Educational Attainment	Primary School	3	0.9%
	Junior High School	6	1.8%
	Senior High School	110	33.7%
	Diploma	44	13.5%
	Bachelor's Degree	141	43.3%
	Master's Degree	21	6.4%
	Doctoral Degree	1	0.3%
Business Sector	Culinary	168	51.5%
	Trade	40	12.3%
	Fashion	52	16.0%
	Agribusiness	13	4.0%
	Beauty Services	2	0.6%
	Automotive	1	0.3%
	Others	50	15.3%
Descriptive Statistics	Average Age (years)	42	–
	Average Duration of Adoption (years)	3	–
	Average Number of Vendors	2	–
Business Location	Sleman Regency	191	58.6%
	Bantul Regency	65	19.9%
	Yogyakarta City	51	15.6%
	Kulon Progo Regency	12	3.7%
	Gunung Kidul Regency	7	2.1%

The descriptive statistics show that the respondents had an average age of 42 years, indicating that the majority of SME owners were in a stable and productive phase of their business life cycle. On average, QR Code Payment had been adopted for three years, suggesting a moderate level of experience with digital payment technologies. Furthermore, respondents engaged with an average of two payment service vendors, reflecting a selective and pragmatic approach to digital payment adoption within their operational context.

In terms of business location, the majority of sampled SMEs were concentrated in Sleman Regency, accounting for 58.6% of the respondents. This was followed by Bantul Regency (19.9%) and Yogyakarta City (15.6%), while a smaller proportion of firms operated in Kulon Progo Regency (3.7%) and Gunung Kidul Regency (2.1%). This spatial distribution reflects the concentration of SME activity in more urbanized and economically dynamic areas of the Special Region of Yogyakarta, providing a relevant context for examining digital payment adoption.

Although the regional distribution of the sample does not strictly follow the population proportions of SMEs in the Special Region of Yogyakarta, the sample remains analytically representative for the objectives of this study. Sleman Regency accounts for 35.19% of the SME population but represents 58.6% of the sample, reflecting its higher level of urbanization, superior digital infrastructure, and greater exposure to QR Code Payment adoption. Bantul Regency contributes 26.84% of the SME population and 19.9% of the sample, indicating a moderate alignment between population structure and sampling. In contrast, Gunungkidul and Kulon Progo jointly comprise

27.81% of the SME population, yet represent only 5.8% of the sample, consistent with their predominantly rural economic profiles and lower levels of digital readiness. Yogyakarta City accounts for 10.13% of the SME population and 15.6% of the sample, reflecting its role as a commercial and service-oriented urban center. Importantly, all five administrative regions are included in the analysis, ensuring full geographic coverage and capturing meaningful contextual variation across SME environments. Consequently, the sample provides a valid and contextually grounded basis for examining QR Code Payment adoption behavior within the regional SME ecosystem.

The revenue distribution of sample indicates that the majority of firms operate at a low turnover level, with more than half of the respondents (50.34%) reporting monthly revenues of ≤ IDR 5 million. Businesses in the middle-revenue category (IDR 5–25 million) account for approximately 35% of the sample, while the proportion of high-revenue firms (> IDR 50 million) remains relatively limited (6.55%) (see Table 2). This pattern reflects a business structure dominated by micro and small enterprises, which is consistent with the prevailing characteristics of SMEs in Indonesia.

Table 2. Respondents' revenue distribution

Monthly Revenue Class	Percentage (%)
≤ IDR 5,000,000	50.34%
IDR 5,000,001–IDR 10,000,000	17.24%
IDR 10,000,001–IDR 25,000,000	17.93%
IDR 25,000,001–IDR 50,000,000	7.93%
IDR 50,000,001–IDR 100,000,000	3.79%
> IDR 100,000,000	2.76%
Total	**100.00%**

3.2 Variable Definition and Measurement

The study employs five focal variables: Perceived Usefulness, Perceived Ease of Use, Digital Literacy, QR Code Payment Adoption, and SMEs Sustainability Performance. In this framework, QR Code Payment Adoption denotes the use of QR Code–based payment systems to support a firm's operations and business activities, encompassing routine transaction processing and other payment-related tasks that are integral to day-to-day workflows, including initiating payments, confirming transactions at the point of sale, reconciling receipts, and handling refunds or adjustments within the same digital environment. To ensure content relevance and conceptual alignment, the study adopted and adapted item questions (Alam et al., 2024; Al-Hattami, 2025; Borah et al., 2022; Chen et al., 2021; Kim et al., 2010; Liu et al., 2025; Maziliauske, 2024; Tung et al., 2008; Türker et al., 2022; Venkatesh & Davis, 2000; Wang, 2025; Zahoor et al., 2023) , with item wording contextualized for SMEs activities and the QR Code payment ecosystem so that each indicator maps clearly onto the intended construct domains while remaining comprehensible to respondents with varied digital experience. The questionnaire was adapted and adopted by carefully considering respondent characteristics and the cultural context. The instrument underwent a rigorous and structured adaptation process, following the measurable procedures recommended by Tsang et al. (2017).

PU refers to individuals' judgments about the extent to which a technology or system improves work effectiveness or simplifies task completion, whereas PEOU captures perceptions of how easy a given technology or system is to operate, including the clarity of procedures and the effort required to learn and execute them. Digital Literacy is defined as the capability to use information and communication technologies to search for, evaluate, produce, and communicate information, encompassing both technical and cognitive skills that enable safe, efficient, and confident participation in digital environments; in practice, this spans basic operational proficiency, critical appraisal of digital content, and secure transacting behavior. SMEs sustainability performance is defined as SME sustainability performance is reflected in competitiveness and the resilience of business outcomes over the past 2 years, benchmarked against principal competitors, thus emphasizing relative standing rather than absolute metrics. All variables were measured on a seven-point Likert scale from 1 (strongly disagree) to 7 (strongly agree), allowing respondents to indicate the intensity of their agreement and facilitating consistent aggregation of item responses at the construct level; higher values indicate stronger endorsement of the statements associated with each latent variable and provide sufficient response granularity for subsequent SEM-PLS analysis.

3.3 Data Analysis Technique

All hypotheses were tested using Partial Least Squares–based Structural Equation Modeling (SEM-PLS). PLS was employed to evaluate the causal relationships among latent variables specified in the conceptual model, with an emphasis on maximizing explained variance in the endogenous constructs and generating prediction-oriented estimates. As a variance-based approach, PLS accommodates modeling with relatively small samples and is

tolerant of departures from multivariate normality, making it suitable for survey data and for models that include numerous indicators and interrelated paths. In contrast to covariance-based SEM—typically used for strict theory confirmation—PLS-SEM prioritizes prediction and theory development, estimating latent variable scores through iterative ordinary-least-squares procedures for the measurement (outer) and structural (inner) models. In this study, PLS-SEM was used to estimate the network of paths among latent variables while simultaneously accounting for measurement error by linking indicators to their underlying constructs, and it readily handles complex specifications such as models with multiple mediators or higher-order constructs.

The PLS-SEM procedure begins with assessment of the measurement model to evaluate construct validity and reliability, followed by assessment of the structural model to examine interrelationships among variables in the structural model; in practice, this sequential process entails inspecting indicator reliability (outer loadings), internal consistency (e.g., α, composite reliability), and convergent validity (e.g., AVE), establishing discriminant validity using established criteria, and only then estimating and interpreting the structural paths. Structural evaluation typically considers collinearity diagnostics among predictors, the magnitude and significance of path coefficients—obtained via nonparametric bootstrapping to yield standard errors, t statistics, confidence intervals, and *p*-values—alongside the model's explanatory power (e.g., R^2 and adjusted R^2), effect sizes (f^2), and, where relevant, measures of predictive relevance for endogenous constructs. This two-stage logic ensures that inferences about causal relations rest on sound measurement before Hypothesis testing proceeds at the structural level, thereby aligning the modeling workflow with best-practice guidance for variance-based SEM (Hair, 2014).

4. Results

4.1 Measurement Model

During development of the measurement model, we assessed internal consistency, discriminant validity, and convergent validity to ensure that the indicators captured the intended latent constructs with adequate precision. Results of the Confirmatory Factor Analysis (CFA) are reported in Table 1, which summarizes the loadings and associated summary statistics for each reflective construct and thereby verifies the prespecified factor structure. Construct reliability was evaluated using Cronbach's Alpha (CA) and Composite Reliability (CR), both of which must reach at least 0.7 to be deemed reliable (Hair & Alamer, 2022; Sekaran & Bougie, 2016). In this context, CA reflects the internal consistency of items under the assumption of equal loadings, whereas CR accommodates differing indicator weights and is therefore well suited to variance-based modeling; taken together, these coefficients provide complementary evidence that the indicators cohere as a scale. All constructs in the model recorded CA and CR values above this threshold, indicating strong reliability and adequate homogeneity within each block of items. Convergent validity was established by requiring each indicator to exhibit a factor loading of at least 0.5; because all indicators met this criterion, convergent validity was achieved for every construct. Convergent validity was further corroborated by Average Variance Extracted (AVE) values, all of which exceeded the minimum 0.5, as shown in Table 1 (Thompson et al., 1994). Collectively, these checks confirm that the measurement model is sound—i.e., the observed variables share sufficient variance with their respective constructs to justify subsequent structural testing and interpretation.

All constructs yielded Cronbach's Alpha values above 0.7, evidencing high item–item consistency and robust measurement reliability across the instrument. Moreover, each construct's AVE exceeded 0.5, confirming adequate convergent validity and indicating that, on average, more than half of the variance in the indicators is explained by the underlying latent variable rather than by measurement error. All indicators loaded significantly, with values ranging from 0.75 to 0.96, demonstrating that the items effectively represent their intended constructs and that the residual variance at the indicator level is relatively modest. These results, considered jointly with the CR and CA diagnostics, suggest that the reflective blocks are internally coherent and that cross-indicator redundancy is limited. Taken together, the evidence indicates that the factor-analytic instrument possesses high validity and reliability, permitting appropriate use of the constructs in subsequent analyses of the relationships between user perceptions of QR Code adoption in transactions and its impact on SMEs' sustainability performance. The results of the validity and reliability tests are briefly presented in Table 3.

Prior to assessing the measurement model's fit, discriminant validity was evaluated. In this context, discriminant validity requires that each latent construct be empirically distinct from the others, complementing convergent validity and internal consistency by ensuring that conceptually different variables are not merely statistical reflections of the same phenomenon. Operationally, this is tested by comparing the Maximum Shared Variance (MSV)—the highest squared correlation a construct shares with any other construct, i.e., the greatest proportion of variance attributable to interconstruct overlap—to its own AVE, the proportion of variance captured by the construct from its indicators relative to measurement error. Discriminant validity is deemed satisfied when the MSV for each latent variable falls below its AVE, indicating that a construct explains more variance in its indicators than it shares with any competing construct, and thus that unique (within-construct) variance predominates. As shown in Table 4, all constructs exhibit MSV values lower than their corresponding AVE,

signaling the absence of problematic cross-construct overlap and no cross-loading across factors. Accordingly, discriminant validity in the measurement model is established, which reduces the risk of latent-level multicollinearity, supports clearer interpretation of structural paths, and provides assurance that subsequent structural estimates reflect relationships among distinct constructs rather than artifacts of measurement confounding.

Table 3. Validity and reliability

Constructs	Code	Loading	AVE	α	$\rho\alpha$	ρc
QR Code Payment Adoption	QA1	0.86	0.74	0.88	0.88	0.92
	QA2	0.87				
	QA3	0.85				
	QA4	0.86				
Digital Literacy	DL1	0.89	0.76	0.92	0.93	0.94
	DL2	0.92				
	DL3	0.92				
	DL4	0.75				
	DL5	0.87				
Perceived Usefulness	PU1	0.91	0.81	0.92	0.93	0.94
	PU2	0.91				
	PU3	0.86				
	PU4	0.93				
Perceived Ease of Use	PeU1	0.95	0.92	0.91	0.93	0.96
	PeU2	0.96				
SME's Sustainability Performance	SP1	0.94	0.87	0.93	0.93	0.95
	SP2	0.93				
	SP3	0.94				

Table 4. Discriminant validity

	Fornell-Larcker Criterion					HTMT Ratio			
	DL	PEU	PU	SP	QA	DL	PEU	PU	SP
DL	0.87								
PEU	0.62	0.96				0.68			
PU	0.65	0.75	0.90			0.70	0.82		
SP	0.55	0.36	0.45	0.93		0.59	0.39	0.48	
QA	0.55	0.55	0.68	0.62	0.86	0.61	0.61	0.75	0.68

4.2 Structural Model

Direct effects were examined to test the hypothesized relationships between Perceived Usefulness and QR Code Payment Adoption (H1), Perceived Ease of Use and QR Code Payment Adoption (H2), Digital Literacy and QR Code Payment Adoption (H3), and QR Code Payment Adoption and SMEs' sustainability performance (H4) as specified in the structural model. In the PLS-SEM context, a direct effect represents the standardized path coefficient linking one latent construct to another while controlling for the remaining paths, thereby indicating the unique contribution of each predictor to its criterion. To evaluate the statistical significance of these links, the direct-effect tests employed a nonparametric bootstrapping procedure with 5000 resamples, which approximates the sampling distribution of the path estimates and provides standard errors, *t* statistics, and *p*-values without relying on multivariate normality. Significance judgments are based on the bootstrapped *p*-values (and the direction of the coefficients), and effect magnitudes assist in substantive interpretation alongside the model's explanatory metrics. Figure 2 presents the testing model and results, displaying the structural paths among the focal constructs together with the estimated coefficients and their associated significance indicators.

The results indicate significant relationships between perceived usefulness and QR code payment adoption (β = 0.52; $p < 0.01$), between digital literacy and QR code payment adoption (β = 0.19; $p < 0.01$), and between QR code payment adoption and SMEs' sustainability performance (β = 0.62; $p < 0.01$). Interpreted in standardized terms, these coefficients imply that higher perceived usefulness is associated with a sizable increase in adoption, while digital literacy exerts a positive—though comparatively smaller—effect; in turn, greater adoption is linked to improved sustainability performance. In the PLS-SEM context, these path estimates reflect the unique contribution of each predictor after accounting for the other variables in the model and derive their significance from the bootstrapped sampling distribution of the coefficients. By contrast, the association between perceived ease of use and QR code payment adoption did not reach significance (β = 0.04; $p < 0.01$), indicating that, within this specification, ease perceptions do not explain additional variance in adoption beyond the other predictors, despite the positive direction of the coefficient. On this basis, H1, H3, and H4 are supported, whereas H2 is not.

For clarity and completeness, a concise summary of the hypothesis tests, relationship significance, and standardized path coefficients is reported in Table 5, which aligns each hypothesis with its corresponding path estimate and significance indicator.

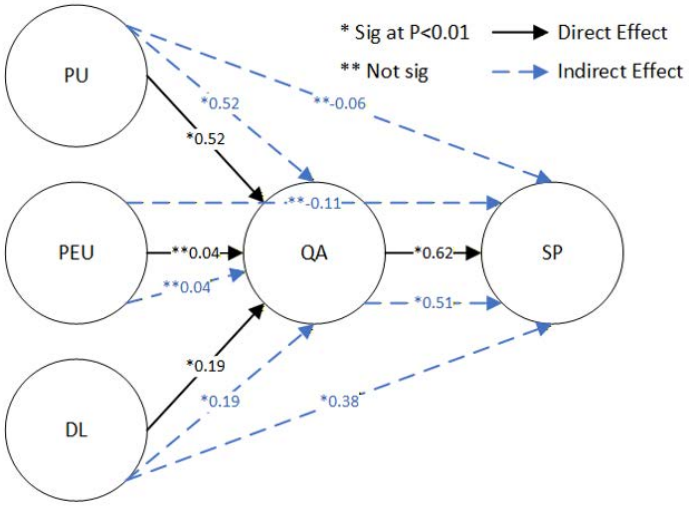

Figure 2. Path model

Table 5. Hypothesis test result

Path	*β*	Mean	St.Dev	*t*	*p*-Values	Note
PU → QA	0.52	0.52	0.08	6.72	0.00	H1 supported
PEU → QA	0.04	0.04	0.07	0.60	0.55	H2 not supported
DL → QA	0.19	0.19	0.06	3.12	0.00	H3 supported
QA → SP	0.62	0.62	0.04	14.74	0.00	H4 supported

4.3 Post-Hoc Analysis

This study also conducted a post-hoc analysis to gain deeper insights into the examined phenomenon, particularly to understand why perceived ease of use did not support QR Code Payment adoption. The post-hoc procedure tested the mediating role of QR Code Payment Adoption (QA) in the relationships between Perceived Usefulness (PU), Perceived Ease of Use (PEU), and Digital Literacy (DL) with SMEs' Sustainability Performance (SP). Mediation effects were assessed using the approach proposed by Zhao et al. (2010). The results of the mediation analysis are presented in Table 6.

Table 6. Mediation analysis

Path	*β*	Mean	St.Dev	*t*	*p*-Values	Type
PU → QA → SP	0.27	0.27	0.05	5.13	0.00	Full Mediation
PU → QA	0.52	0.52	0.08	6.71	0.00	
QA → SP	0.51	0.51	0.07	7.40	0.00	
PU→ SP	-0.06	-0.05	0.09	0.63	0.53	
PEU → QA → SP	0.02	0.02	0.04	0.61	0.54	Non-Mediation
QA → SP	0.51	0.51	0.07	7.40	0.00	
PEU → QA	0.04	0.04	0.07	0.62	0.53	
PEU → SP	-0.11	-0.12	0.07	1.61	0.11	
DL → QA → SP	0.09	0.10	0.03	2.92	0.00	Complementary
DL → QA	0.19	0.19	0.06	3.13	0.00	
QA → SP	0.51	0.51	0.07	7.40	0.00	
DL → SP	0.38	0.37	0.08	4.94	0.00	

The mediation analysis indicates that QA fully mediates the relationship between PU and SP ($\beta = 0.27$, $t = 5.13$, $p < 0.001$), as the direct effect of PU on SP is not significant ($\beta = -0.06$, $p = 0.53$), implying that perceived usefulness enhances sustainability performance only when it is converted into actual QR Code Payment adoption. In contrast, DL demonstrates a complementary mediation pattern ($\beta = 0.09$, $t = 2.92$, $p < 0.01$), whereas PEU shows neither significant direct nor indirect effects, confirming that perceived ease of use does not materially contribute to adoption-driven sustainability performance outcomes in the SME context.

The mediation results show a clear distinction between the two pathways. QR Code Payment adoption fully mediates the relationship between perceived usefulness and SMEs' sustainability performance, indicating that usefulness perceptions alone do not translate into performance unless they are realized through actual technology use. In contrast, QR Code Payment adoption plays a complementary mediating role in the relationship between digital literacy and sustainability performance, suggesting that digital skills contribute to performance both directly and by facilitating effective technology adoption. Overall, these findings emphasize the central role of QR Code Payment adoption as the mechanism through which perceptions and capabilities are transformed into sustainability performance outcomes (Hair et al., 2019; Zhao et al., 2010).

5. Discussion

The findings provide a more comprehensive account of the determinants of QR Code Payment Adoption and its implications for SMEs sustainability performance in Indonesia. By integrating TAM and RBV and applying a quantitative SEM-PLS approach, the study yields several theoretically and practically salient results. The joint use of TAM and RBV enables a simultaneous focus on belief-driven acceptance (e.g., perceived usefulness and perceived ease) and capability-based readiness (e.g., digital literacy), while the variance-oriented nature of SEM-PLS supports prediction of adoption outcomes in settings characterized by heterogeneous firm resources and evolving digital infrastructures. In this way, the analysis connects micro-level user perceptions to organizational capabilities and, ultimately, to sustainability-oriented performance, offering a cohesive explanation of how and why QR Code Payment diffuses among Indonesian SMEs. Moreover, by emphasizing both cognition (what users believe) and capacity (what firms can mobilize), the framework clarifies the channels through which everyday payment choices translate into measurable performance improvements over time, and it delineates where managerial interventions—training, process redesign, or value communication—are likely to yield the greatest marginal gains.

PU exerts a significant effect on QR Code Payment Adoption (β = 0,52; p < 0,001). This aligns with TAM (Davis, 1989), which posits that beliefs about a system's benefits drive usage intentions. In practice, SMEs owners who believe QR Code Payment enhances transactional efficiency, broadens market reach, and signals professionalism are more likely to adopt it—consistent with prior evidence (Truc, 2024; Türker et al., 2022). Put differently, when decision makers anticipate concrete performance gains—such as faster checkout, easier reconciliation, and reduced cash-handling risks—PU strengthens attitudes toward use and translates into higher adoption propensity (Davis, 1989; Truc, 2024; Türker et al., 2022). This pattern suggests that communicating clear value propositions and demonstrating functional improvements at the point of use can be decisive in moving firms from trial to consistent utilization, particularly when demonstrations, case examples, or built-in analytics make benefits visible within routine workflows.

By contrast, PEOU does not significantly influence QR Code Payment Adoption (β = 0.04; p = 0.55). Although this departs from the classical TAM hypothesis, a plausible explanation is that SMEs actors are increasingly accustomed to digital applications and expect baseline usability; thus, ease becomes less decisive than demonstrable functionality and direct benefits. This pattern is congruent with TAM2 (Venkatesh & Davis, 2000), which suggests that once users are familiar with a technology, PU predominates, and with meta-analytic trends in various sectors (e.g., Industry 5.0) where PU remains a strong predictor while PEOU's effect attenuates over time. In mature app ecosystems, ease may operate as a threshold attribute—necessary but not differentiating—so variation in perceived benefits, rather than usability, explains incremental adoption decisions (Venkatesh & Davis, 2000). Accordingly, interventions that merely simplify interfaces without highlighting tangible business gains may yield limited marginal impact on adoption, whereas efforts that surface real-time value (e.g., faster settlement, fewer errors) are more likely to shift behavior. In the Yogyakarta SME context, perceived ease of use did not significantly predict QR Code Payment adoption because QR-based transactions are already viewed as intuitively simple and strongly supported by the payment ecosystem, making ease of use a basic hygiene factor, while performance-oriented beliefs and digital capabilities play a much more decisive role in shaping adoption decisions. This phenomenon is reinforced by the mediation analysis, which shows that QR Code Payment adoption does not mediate the relationship between PEU and performance.

The non-significant effect of PEOU on QR Code Payment Adoption can be explained by the maturity of users and the contextual characteristics of the sampled SMEs. More than 63% of respondents hold at least a diploma degree, with 43.3% holding a bachelor's degree, indicating sufficient cognitive capacity and digital familiarity to treat QR-based payments as an intuitive, routine technology rather than a system requiring usability evaluation. This interpretation is reinforced by the average adoption duration of approximately three years, suggesting that most SMEs have moved beyond the initial learning phase, where PEOU typically plays a stronger role, toward a post-adoption stage in which ease of use becomes a taken-for-granted attribute. Moreover, the dominance of micro and small enterprises—over 85% generating monthly revenues below IDR 25 million—implies that adoption decisions are primarily driven by performance-oriented considerations, such as transaction efficiency, customer convenience, and business continuity, rather than by perceptions of operational simplicity. This tendency is further

accentuated in transaction-intensive sectors such as culinary and trade, which account for the majority of the sample, where QR Code Payment has effectively become a market-imposed standard. Consequently, the limited variability in PEOU perceptions across respondents reduces its explanatory power, rendering ease of use insufficient to significantly influence adoption when compared with more salient drivers such as perceived usefulness and capability-based factors.

Digital Literacy also significantly affects QR Code Payment Adoption ($\beta = 0.19$; $p < 0.001$), reinforcing the RBV view that internal resources enhance a firm's capacity to leverage technology. SMEs with higher digital literacy display greater confidence in using digital payments and are better positioned to address technical constraints and information risks, echoing prior work (Ullah et al., 2022; Zahoor et al., 2023). From a capability perspective, literacy equips owners and staff to configure applications, interpret digital records, and troubleshoot routine issues—competencies that reduce perceived barriers and convert intention into sustained use (Ullah et al., 2022; Zahoor et al., 2023). Thus, capability building functions not only as an antecedent to initial adoption but also as an enabler of continued, effective utilization across diverse transaction contexts, helping firms integrate payment data with inventory, accounting, and customer-relationship processes.

QR Code Payment Adoption, in turn, has a significant impact on SMEs' Sustainability Performance ($\beta = 0.62$; $p < 0.001$). This supports the argument that digital technologies can deliver sustained strategic value for SMEs: adoption not only improves transactional efficiency but also strengthens financial transparency, builds customer trust, and reduces paper use (eco-friendly), in line with earlier studies (Maziliauske, 2024; Nurchayati et al., 2024). Framed through RBV, QR-based payments become a lever through which firms transform digital capabilities into triple-bottom-line outcomes—economic (higher turnover and efficiency), social (greater customer satisfaction and inclusivity), and environmental (lower material waste) (Maziliauske, 2024; Nurchayati et al., 2024). The magnitude of the effect further implies that payment digitalization constitutes more than a back-office upgrade; it is a strategic complement that can reinforce resilience and competitiveness by professionalizing customer touchpoints and improving data visibility.

Managerially, the significance of Perceived Usefulness and Digital Literacy implies that adoption strategies should emphasize demonstrable value and targeted capability building (Samputra & Alfarizi, 2025). In practice, Indonesian government bodies can leverage these insights to intensify digital and financial literacy campaigns that go beyond QR Code Payment technical operation to highlight efficiency gains, transactional credibility, and customer loyalty. QR Code Payment providers can likewise design more value-focused onboarding and app features—such as automated financial reports and small-business transaction tracking—to stimulate perceived usefulness (Affandi et al., 2024). Pairing these initiatives with clear communication of security protocols and responsive customer support can further strengthen perceived benefits and lower residual hesitation (Affandi et al., 2024; Samputra & Alfarizi, 2025). For ecosystem coordinators, aligning merchant education with simple analytics dashboards may help SMEs convert payment data into actionable insights, thereby reinforcing the usefulness–adoption link and supporting continuous improvement in day-to-day operations.

The positive effect of QR Code Payment Adoption on SME sustainability performance indicates that digital technology can serve as a strategic instrument for economic (higher turnover and efficiency), social (greater customer satisfaction and inclusivity), and environmental (lower paper use) outcomes. Sustainable innovation need not hinge on complex technologies; context-appropriate, simple solutions can be equally transformative. For the Indonesian SMEs sector, these results offer actionable guidance to cooperative agencies and SME support organizations to embed digitalization into entrepreneurship training, financial-management mentoring, and data-driven business-model development—so that QR Code Payment Adoption becomes a core strategic lever for long-term competitiveness and sustainability (Brenner & Hartl, 2021; Broccardo et al., 2023; Pizzi et al., 2021). In sum, prioritizing usefulness communication and literacy enhancement, while maintaining baseline usability, provides a clear pathway to scale adoption and amplify sustainability gains across the SMEs landscape, especially as digital infrastructures deepen and merchant–consumer networks continue to expand.

The different mediation patterns identified in this study—full mediation for the PU→QA→SP relationship and complementary mediation for the DL→QA→SP relationship—offer strong theoretical support for integrating TAM and RBV in explaining SMEs' sustainability performance. From a TAM perspective, perceived usefulness reflects SMEs' beliefs about the performance benefits of QR Code Payment; however, the presence of full mediation indicates that these beliefs remain largely aspirational unless they are translated into actual adoption. This finding aligns with the core TAM argument that beliefs influence outcomes primarily through realized system use rather than through perceptions alone (Davis, 1989; Venkatesh et al., 2003). By contrast, the complementary mediation observed in the digital literacy pathway is consistent with RBV logic, where firm-specific capabilities may have a modest direct effect on performance while simultaneously strengthening outcomes through their deployment via specific technologies (Barney, 1991; Teece, 2007). Importantly, the significant indirect effect through QR Code Payment adoption confirms that even valuable digital capabilities must be operationalized through concrete technology application to generate sustainable performance advantages. Taken together, these results highlight QR Code Payment adoption as a critical bridging mechanism that activates usefulness perceptions and mobilizes digital literacy into routinized business practices, thereby validating the conceptual coherence and

explanatory power of combining TAM and RBV in the context of SME digital transformation and sustainability performance (Hair et al., 2019; Zhao et al., 2010).

From a practical standpoint, the mediation analysis's findings suggest that sustainability performance gains do not emerge automatically from favorable perceptions or isolated digital capabilities. Rather, enterprises need to simultaneously strengthen employees' perceived usefulness of QR Code Payment and enhance digital literacy, while ensuring that these attributes are translated into continuous and routinized adoption within daily business operations. Training initiatives that emphasize concrete performance benefits—such as transaction efficiency, sales traceability, and cash-flow visibility—should be aligned with capability-building efforts that improve merchants' ability to use digital payment systems confidently and strategically. Importantly, without sustained usage, perceived usefulness and digital literacy remain latent resources that fail to generate value. Therefore, firms and ecosystem actors should focus on embedding QR Code Payment into routine transactions as it is this ongoing application that ultimately enables enterprises to convert technological beliefs and capabilities into measurable economic sustainability outcomes.

6. Limitations and Future Research

Although this study offers a meaningful contribution, several limitations warrant acknowledgment. First, data collection centered on a specific demographic group in Indonesia, which may limit the generalizability of the findings to other regions or cultures; cross-national and cross-regional comparisons would be valuable, especially where payment ecosystems, regulatory maturity, or consumer norms differ. Second, the analysis focuses specifically on QR code–based payment technologies, without considering other forms of digital payment that may exhibit distinct adoption determinants; comparative designs that include, for example, bank transfers, contactless card/NFC, or installment/BNPL options could reveal technology-specific drivers. Follow-up studies are therefore encouraged to broaden the geographic and cultural scope to assess how cultural dynamics shape QR payment acceptance. In addition, examining how trust-building strategies influence consumer adoption represents a promising avenue—such as assessing the role of perceived provider reputation, transparency of fees, and dispute-resolution mechanisms—as does investigating the effects of regulatory frameworks (e.g., interoperability standards, data-protection safeguards) and alternative marketing approaches (e.g., merchant incentives, tailored onboarding) on digital payment uptake. Taken together, these extensions would provide a stronger basis for understanding the complexity of technology-adoption behavior in digital finance.

Several methodological and theoretical constraints also merit attention. Methodologically, a survey-based quantitative design does not capture contextual nuances and the subjective experiences of SMEs actors; qualitative or mixed-method approaches are recommended for future research to enrich interpretation and uncover mechanism detail. With respect to data, the limited geographic coverage may constrain generalization given interregional differences among SMEs, including potential variation by industry, firm size, or urban–rural location. Furthermore, although the questionnaire adaptation followed rigorous procedures and methodological standards, interpretation errors during item response—such as misunderstandings of contextual meaning—may still occur. The exclusive focus on QR Code Payment similarly narrows insight into other relevant digital payment forms and precludes technology-by-context comparisons. Theoretically, although the study integrates TAM and RBV, it does not incorporate external factors such as institutional pressures or social norms; expanded models that include meso- and macro-level influences could better account for adoption heterogeneity. Future research should therefore widen the range of settings and technologies, employ longitudinal or multi-source designs (e.g., administrative/transactional data alongside surveys), and integrate additional theories to strengthen understanding of the adoption and impacts of digital technologies in the SMEs context. Moreover, subsequent studies could incorporate variables such as government support (Nugroho et al., 2024), risk (Nugroho & Novitasari, 2023), system quality (Nugroho et al., 2019) , or alignment (Nugroho et al., 2020) into the model for analysis.

Moderating variables such as Government Support were not incorporated because existing studies have consistently confirmed its positive influence on digital payment adoption (e.g., Nugroho et al. (2024)), while the present research intentionally concentrates on the internal belief–capability–adoption–performance mechanism rather than external policy-driven factors. Similarly, Industry Type was not modeled as a moderator, as the core use of QR Code Payment—transaction settlement—remains largely uniform across the dominant sectors represented in the sample, including culinary, fashion, and trade, reducing the explanatory value of industry heterogeneity for the adoption–performance relationship. Future studies may broaden this framework by integrating institutional or policy-related variables and by exploring industry-specific effects, particularly within niche or highly specialized sectors, to provide a more nuanced understanding of QR Code Payment adoption and its performance implications.

7. Conclusion

This study advances the literature by identifying the determinants that motivate consumers in Indonesia to adopt

QR-based payment technologies for transactions via mobile devices. Built on a rigorous quantitative design and grounded in TAM and RBV, the analysis yields credible insights with potential for broader generalization by linking users' belief structures to underlying capability conditions. In particular, TAM clarifies how evaluations formed at the individual level translate into intention and behavior, while RBV frames digital literacy as an internal resource that conditions the effectiveness of technology deployment—together offering a coherent account of why some users adopt quickly while others hesitate. Extending this logic to the Indonesian context, the study highlights the salience of everyday, routine payment scenarios in which perceived benefits and user readiness interact to shape adoption trajectories across heterogeneous consumer segments, including differences in experience, risk tolerance, and familiarity with mobile interfaces. It underscores the need to understand users' functional and affective responses to QR payment systems and, specifically, demonstrates significant effects of perceived ease of use and digital literacy on the adoption of QR Code Payment. Moreover, the results indicate that adoption is closely associated with improvements in SMEs' sustainability performance, suggesting that everyday payment choices can aggregate into meaningful economic, social, and environmental gains when scaled across merchant networks and embedded in routine business practices. Taken together, the study offers a nuanced account of the factors shaping consumer readiness to embrace QR payment systems and, in turn, provides actionable guidance for service providers to tailor offerings to user preferences and needs—for example, by simplifying interfaces, reducing cognitive effort, and embedding literacy-oriented onboarding, as well as by communicating clear value propositions for small-business users and ensuring consistent post-adoption support. As such, it lays an important foundation for future research and practical developments in the domain of digital payment technology adoption, establishing a platform on which comparative studies across regions, sectors, and user segments can build, and against which subsequent design and policy interventions can be evaluated to enhance inclusion and long-term impact.

Author Contributions

Conceptualization, M.A.N.; methodology, M.A.N.; validation, M.A.N., D.H., and A.K.D.; formal analysis, M.A.N. and R.A.Z.N.; investigation, M.A.N. and R.A.Z.N.; resources, R.A.Z.N.; data curation, M.A.N.; writing—original draft preparation, R.A.Z.N.; writing—review and editing, M.A.N.; visualization, M.A.N.; project administration, R.A.Z.N.; funding acquisition, M.A.N., D.H., R.A.Z.N., and A.K.D. All authors have read and agreed to the published version of the manuscript.

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Data Availability

The data used to support the research findings are available from the corresponding author upon request.

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Conflicts of Interest

The authors declare no conflict of interest.

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