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Enhancing Digital Literacy for Sustainable Economic Development

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ABSTRACT

Objective: This study examines the adoption of the Quick Response Code Indonesian Standard (QRIS) as a cross-border digital payment system in Southeast Asia, with a particular focus on Indonesia and Malaysia. It investigates the barriers to QRIS adoption and analyzes how digital literacy can facilitate its implementation in promoting financial inclusion, economic efficiency, and sustainable development. **Method:** The research employs a qualitative literature review and field observation approach to identify the main obstacles to QRIS adoption and how digital literacy can mitigate these barriers. **Results:** The findings indicate that inadequate digital infrastructure, cybersecurity concerns, and limited public awareness remain the primary barriers to QRIS adoption. Strengthening digital literacy and cross-border institutional collaboration can increase public trust, encourage QRIS utilization in the tourism sector, and support green economy initiatives by reducing dependence on cash-based transactions. **Novelty:** The proposed framework integrates digital literacy, cross-border QRIS adoption, and green economy development within the Southeast Asian context. It contributes to the literature by positioning digital literacy as a key driver of sustainable digital payment adoption beyond the technological and financial inclusion perspectives emphasized in previous studies.

INTRODUCTION

In the rapidly evolving digital era, digital literacy has become a fundamental skill for individuals to participate fully in a technology-based society (Prasastiningtyas et al., 2024; Reddy et al., 2022). Digital literacy encompasses the use of digital devices and a broader understanding of how to access, evaluate, manage, and communicate information through digital technology (Ng, 2018; Tinmaz et al., 2022). In sustainable economic development, digital literacy is vital in encouraging the adoption of digital technologies, including electronic payments and digital financial services, which can increase financial inclusion, transparency, and economic efficiency (Lankshear & Knobel, 2015; Sarah, 2024).

Adopting digital payments, such as using QR codes through the Quick Response Code Indonesian Standard (QRIS), has shown great potential to support economic development in Southeast Asia (Sarah, 2024). In Indonesia and Malaysia, the adoption of digital payments continues to increase along with government policies that encourage digital economic transformation. However, low levels of digital literacy among the public still need to be addressed to encourage wider adoption (Hussain & Phulpoto, 2024; Ng, 2018). Although cross-border digital payment systems such as QRIS offer a variety of benefits, their adoption still needs to overcome several significant obstacles. These obstacles include users' technical incomprehension, lack of supporting infrastructure, data security issues, and low public awareness of the benefits of digital payment systems (Lankshear & Knobel, 2015).

One key factor that can help overcome these barriers is digital literacy. By improving digital literacy, individuals can better understand and use digital payment technology, thereby overcoming security concerns, technical difficulties, and a lack of understanding of QRIS (Ng, 2018; Sarah, 2024). China's evolution in digital tourism has gone through several distinct phases: the initial digitalization period (1980-1996), the digital growth phase (1997-2006), and the rapid digital advancement phase (2007-2023). These developments have been driven by advancements in digital technology, which have significantly enhanced the tourism industry's quality, efficiency, and intelligence (Ying et al., 2024). China is a leading example of the successful adoption of digital payment systems, notably WeChat Pay and Alipay (Sleiman et al., 2021).

In tourist-heavy cities like Beijing and Shanghai, these systems are integrated across various industries, enabling seamless cashless transactions for domestic and international tourists. For instance, attractions such as the Great Wall of China promote cashless payments to streamline ticket purchasing, reduce long queues, and minimize the handling of physical currency, thus supporting sustainability efforts (Mhlanga & Sethi, 2024). Moreover, Alipay operates internationally, offering various services—including payments, financial management, insurance, lending, and credit scoring—in countries like the USA, Canada, the UK, and Australia (Sun & Grigoriev, 2023). This comprehensive financial ecosystem highlights the potential for digital payment systems to enhance tourism experiences and financial inclusion globally.

The adoption of mobile technologies in tourism has demonstrated the potential to significantly reduce the environmental impact of tourism-related activities, particularly regarding resource consumption and waste generation (Pesonen & Horster, 2012; Zhang & Deng, 2024). Information and Communication Technology (ICT), including digital payment platforms, reduces the reliance on physical transactions in tourism, decreasing the sector's resource intensity and overall environmental burden (Gössling, 2016; Khando et al., 2022). For example, in sub-Saharan Africa, the transition to mobile payments has shown notable environmental benefits by reducing dependence on physical cash, which is both resource-intensive and environmentally costly to produce and transport (Humbani & Wiese, 2018; Vora et al., 2021).

In Southeast Asia, similar studies have emphasized the potential for mobile payment systems, such as the Quick Response Code Indonesian Standard (QRIS), to drive green economy initiatives by reducing the environmental costs associated with tourism-related transactions (Xiao et al., 2023). These systems are particularly beneficial in reducing the production and transportation of physical currency, which aligns with global efforts to build more sustainable tourism infrastructures (Buhalis et al., 2023; Orbelyan, 2024). However, most studies to date have focused on the domestic applications of these systems and have yet to explore the crucial role of cross-border interoperability in enhancing sustainable tourism practices. Cashless payment systems utilizing QR codes can offer significant advantages for reducing environmental costs associated with physical cash transactions, making them an essential element in the push toward sustainable tourism development (Ojo et al., 2022).

RESEARCH METHOD

This study uses a qualitative approach to understand the phenomena related to the research topic deeply. Data were collected through two main methods: literature study and field observation (Taherdoost, 2022). A literature review was conducted to identify key concepts, understand relevant theories, and identify research gaps that warrant further investigation. The researcher reviewed the literature, including academic journals, books, articles, and official documents, related to this topic. The results of this literature study were used to build a theoretical framework that became a reference in data analysis (Bingham, 2023; Khansa et al., 2026). A simple qualitative research workflow is shown in Figure 1.

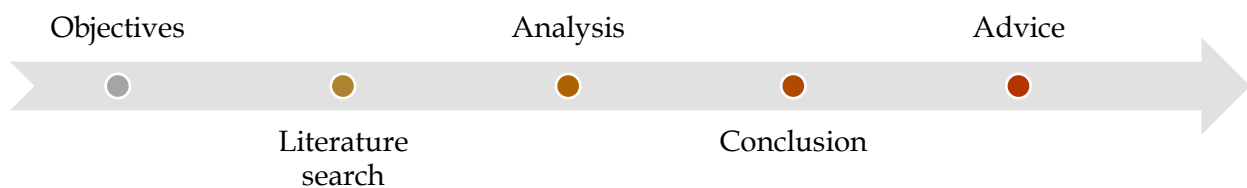


Figure 1. Research design

Meanwhile, field observation was used to collect primary data by directly observing phenomena. This observation is non-participant, where the researcher observes the research subjects' behavior, activities, and interactions in relevant locations without being directly involved (Timothy, 2026). The researcher records the findings as field notes and, if necessary, documents them through photos or videos to enrich the descriptive data. The research location was selected based on its relevance to the topic being studied, and the researcher ensured that observations were carried out systematically using previously prepared observation guidelines. Data obtained from these two methods were analyzed using a qualitative approach (Pyo et al., 2023; Renjith et al., 2021). The analysis process includes coding data to identify key themes, thematic analysis to relate field findings to theories found in the literature, and data triangulation to increase the validity of the findings. The results of the analysis are then used to draw conclusions and provide relevant recommendations based on the research findings.

RESULTS AND DISCUSSION

QRIS Challenges

In the context of cross-country QRIS adoption in Southeast Asia, particularly in Indonesia and Malaysia, several significant obstacles must be addressed to encourage digital literacy and support sustainable economic development. Key challenges include limited technological infrastructure, lack of trust in data security, and low user awareness of the benefits of cross-country QRIS. The low level of digital literacy in the community exacerbates these obstacles. According to the Economic Research Institute for ASEAN and East Asia, one of the primary challenges in ASEAN is the population's need for understanding digital technology (Ha & Chuah, 2023), resulting in the slow adoption of digital payment systems across several countries (Ayob, 2021). In the case of QRIS, this

challenge is more pronounced in Indonesia and Malaysia, where public awareness of the advantages of cross-border QR use remains low. This lack of understanding also impacts public trust in the security of digital payments.

Addressing these challenges requires prioritizing digital literacy. Educating users about utilizing QRIS effectively and highlighting its security and economic benefits are essential (Hartono et al., 2024). This focus aligns with ASEAN's broader circular economy goals, where digital literacy can help increase resource efficiency and reduce reliance on unsustainable economic models. Improving digital literacy will facilitate greater technology adoption, promote financial inclusion, and bolster economic resilience. The Sustainable Development Priorities for Southeast Asia report also underscores the need for innovation and digitalization to support sustainable economic growth (Suranto et al., 2026). One crucial strategy is to enhance cross-sector collaboration between governments, the private sector, and the public to raise awareness of the advantages of digital payment technology and the significance of digital literacy in navigating modern economic challenges. Digitalization can drive value chain efficiency, while strengthening digital literacy can reduce digital inequality, ensuring more inclusive participation in the digital economy (Wibowo et al., 2023).

QRIS Implementation

In the context of cross-country QRIS implementation, increasing digital literacy offers a strategic solution to drive the broader adoption of environmentally friendly digital payment systems, thus supporting sustainable economic development. An analysis of QRIS adoption in Indonesia and Malaysia reveals several ongoing challenges despite notable advancements, especially in urban areas (Prawitasari et al., 2024). Small and medium enterprises (SMEs) prefer cash payments, while cross-border payment issues remain prevalent (Sangwa et al., 2024). They emphasize the environmental benefits of QRIS, such as reducing cash transactions and lowering carbon emissions associated with the physical transport of money. Despite QRIS aligning well with green economy objectives, regulatory and technological inconsistencies hinder the achievement of complete interoperability between the two countries. Cross-border collaboration is critical to addressing these barriers, facilitating the adoption of QRIS in the tourism industry, and contributing to sustainable development across Southeast Asia (Susilo, 2024).

In Indonesia, QRIS is widely adopted among younger generations and in tourist-heavy urban areas. However, adoption of SME could be faster, as many businesses favor cash transactions. In contrast, QR payment systems in Malaysia are more universally available, but Indonesian tourists often face compatibility issues between QRIS and Malaysian systems. Currently, Duitku is the leading platform supporting Indonesian QR codes in Malaysia. While QRIS adoption in both countries shows promise, regulatory differences and inconsistent system support remain significant challenges for cross-border payments. Enhanced collaboration between Indonesia and Malaysia could streamline QRIS adoption, supporting digital payment convenience and environmental

sustainability by reducing reliance on physical currency exchanges and minimizing the carbon footprint of cash transport.

There are notable differences in QRIS implementation and success between Indonesia and Malaysia. While QRIS is widely used in Indonesia's urban centers and tourist destinations, SME reliance on cash slows overall adoption. This reliance diminishes the potential environmental benefits of QRIS, as cash handling continues to demand physical resources and transportation (Nabila & Putri, 2025). Additionally, regulatory barriers inhibit the expansion of cross-border QRIS payments. Despite these challenges, QRIS has significantly reduced cash usage and supported green economy objectives. However, compatibility issues persist, particularly in cross-border transactions. In Malaysia, most merchants accept QR payments, but Indonesian tourists struggle with incompatibility between their banks and local systems (Wang, 2025). Regulatory differences and challenges in financial transactions and currency exchange impede seamless QRIS adoption across Southeast Asia. Merchants may accept QR payments widely, but accessibility remains challenging, particularly for Indonesian banks such as BRI, which cannot process payments to Maybank (Rahman et al., 2020).

Sustainable QRIS

Tourists are becoming increasingly aware of the environmental benefits of QRIS, although this awareness varies between Indonesia and Malaysia. Integrating cashless payment systems like QRIS into the tourism industry is vital to reducing the environmental impact of traditional cash transactions, such as physical currency production and transport. In Malaysia, the environmental benefits of QR payments have gained recognition, especially following the COVID-19 pandemic, which accelerated the shift toward contactless transactions (Ojo et al., 2022). While reducing physical currency and its associated environmental costs is crucial, more effort is needed to educate consumers and merchants on the long-term sustainability advantages of cashless payments (Rahman et al., 2020). Promoting QRIS as part of the digital economy is aligned with efforts to reduce tourism's environmental footprint, especially in popular destinations (Sari et al., 2022). However, realizing QRIS's full environmental benefits requires greater SME adoption and a broader cultural shift toward digital payments (Nada et al., 2021).

In Southeast Asia, significant barriers remain to adopting QRIS as a cross-border payment method, particularly in Indonesia and Malaysia. Digital literacy, however, holds great potential for overcoming these challenges. Critical barriers to QRIS adoption include:

1. Lack of Digital Literacy and Technical Skills

A significant portion of Indonesia's population needs more digital literacy to utilize QRIS effectively. Research from India shows that digital literacy enables greater access to government services, participation in the digital economy, and digital transactions. This is relevant for Indonesia and Malaysia, where understanding QRIS remains limited (Sarah, 2024; Chuah et al., 2021).

2. Infrastructure Constraints and Transaction Failures

Uneven internet access and network instability cause frequent transaction failures when using QRIS. In Malaysia, perceived performance risks and uncertainty about merchant acceptance also pose barriers (Chuah et al., 2021). Strengthening supporting infrastructure is vital to resolving these issues.

3. Privacy and Security Concerns

Perceived privacy risks deter users from adopting QRIS, as concerns over data misuse and information leaks make users hesitant to adopt digital payments (Chuah et al., 2021).

Addressing these barriers requires digital literacy efforts to empower users with the knowledge and skills to use QRIS confidently and securely. For example, digital literacy training in India has shown that proper use of digital technology increases participation in the digital economy. Similar initiatives in Indonesia and Malaysia could boost QRIS awareness and adoption. Although Bank Indonesia and the Malaysian government have initiated efforts to encourage cross-border QRIS adoption, a more aggressive digital literacy campaign is necessary to educate users on using this technology effectively (Sarah, 2024). So, the implications and recommendations are,

1. Digital Literacy Training Programs

Governments and financial institutions should provide digital literacy programs to educate the public on using QRIS, maintaining data security, and leveraging the technology for cross-border transactions.

2. Regional Collaboration

Cross-border collaboration in ASEAN must be enhanced, particularly in implementing security standards and facilitating transactions. Bank Indonesia's QRIS Cross-Border initiative is a positive step, but further cooperation with central banks and financial institutions in Malaysia and other ASEAN countries is needed.

3. Strengthening Technological Infrastructure

Improved internet access and technical support for merchants and users are critical to overcoming infrastructure limitations and ensuring smooth QRIS transactions (Sarah, 2024).

QRIS can play a pivotal role in supporting sustainable economic development in Southeast Asia by strengthening digital literacy and overcoming technological barriers. Moreover, integrating QR payments with green economy initiatives can drive sustainable tourism. Encouraging cashless payments and incorporating environmental criteria into payment systems can further enhance this objective. Collaborative efforts to promote eco-friendly tourism through digital payment systems will help balance economic growth with environmental sustainability across the region (Juwita et al., 2021). Tourists' adoption of QRIS in Indonesia, Malaysia, and Singapore is progressing at different rates. However, cross-country collaboration offers significant potential for creating a sustainable payment ecosystem within the tourism sector.

Digital Literacy as an Enabler of QRIS Adoption

Digital literacy functions as a fundamental enabler of cross-border QRIS adoption by improving users' ability to understand, evaluate, and utilize digital payment technologies

effectively. Individuals with higher levels of digital literacy are more likely to recognize the convenience, security, and efficiency of QRIS, thereby reducing perceived risks associated with digital transactions (Asaif et al., 2025; Riskawati et al., 2025; Saputra et al., 2025). Moreover, digital literacy enhances users' confidence in protecting personal information and conducting secure financial transactions, which is particularly important in cross-border payment environments where concerns regarding data privacy and cybersecurity remain significant. Consequently, strengthening digital literacy can increase public trust and encourage wider acceptance of QRIS among consumers, merchants, and tourism stakeholders (Kencanawati et al., 2025; Nugroho & Adiyanto, 2025).

Beyond promoting technology adoption, digital literacy also contributes to the sustainability of the digital economy by encouraging responsible and efficient financial behavior. Increased understanding of digital payment systems enables users to transition from cash-based transactions to cashless alternatives, reducing the environmental impacts associated with cash production, transportation, and processing (Rui et al., 2023). In the tourism sector, greater adoption of QRIS can facilitate seamless cross-border transactions, improve tourists' payment experiences, and support the development of sustainable tourism ecosystems across Southeast Asia. Therefore, integrating digital literacy initiatives with QRIS implementation strategies is essential to maximizing the economic, social, and environmental benefits of digital payment systems while strengthening regional financial integration.

CONCLUSION

Fundamental Findings: In the rapidly evolving digital era, digital literacy is essential for individuals to participate fully in a technology-based society. Digital literacy includes the use of digital devices and broader capabilities in accessing, evaluating, managing, and communicating information through digital technology. In sustainable economic development, digital literacy plays a vital role in driving the adoption of digital technologies, including electronic payments and digital financial services, which can improve financial inclusion, transparency, and economic efficiency. Adopting digital payments, such as QR codes through the Quick Response Code Indonesian Standard (QRIS), shows great potential to support economic development in Southeast Asia. However, the community's low level of digital literacy is a significant obstacle that must be overcome to encourage wider adoption. Although cross-border digital payment systems such as QRIS offer various benefits, their adoption still faces several significant obstacles, including infrastructure limitations, data security concerns, and a lack of public understanding of their benefits. **Implication:** This study identifies that increasing digital literacy can be a strategic solution to overcome these obstacles. With better digital literacy, individuals will better understand and effectively utilize digital payment technology, overcoming security concerns, technical difficulties, and lack of familiarity with QRIS. Cross-border collaboration in ASEAN, especially between Indonesia and Malaysia, is crucial to drive interoperability and infrastructure development supporting

QRIS adoption. It can significantly support sustainable economic development in Southeast Asia by strengthening digital literacy and addressing technological barriers. Integrating QR payments with green economy initiatives can drive sustainable tourism and reduce the environmental footprint of cash-based transactions. Cross-border collaboration and solid digital literacy education will be vital to creating a more inclusive and environmentally friendly digital payment ecosystem in the tourism sector.

Limitation: This study has several limitations that open opportunities for further research. First, the limited empirical data requires a broader quantitative study to measure the impact of digital literacy on QRIS adoption. Second, focusing only on Indonesia and Malaysia limits a broader regional view, so other ASEAN countries must be studied. Third, the role of the private sector in driving QRIS adoption has yet to be explored in depth; further research could examine government-private collaboration. Fourth, dynamic regulatory changes and their impact on cross-border payments need further study. Finally, social and cultural factors that influence technology adoption must be studied more deeply. **Future Research:** Employ large-scale quantitative or mixed-method approaches involving multiple ASEAN countries to examine the influence of digital literacy on the adoption of cross-border QRIS payments and their contribution to sustainable economic development. Additionally, future studies should investigate the roles of government-private sector collaboration, regulatory harmonization, and socio-cultural factors in strengthening digital payment ecosystems and promoting sustainable tourism through interoperable QR payment systems.

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AUTHOR CONTRIBUTIONS

Rafika Arsyad conceived the study, developed the conceptual framework, supervised the research process, coordinated the project, and led the manuscript preparation. **Moch. Fathoni** contributed to the conceptual framework, literature review, and validation of the research instruments. **Ardiansah** contributed to data collection, data curation, and interpretation of the findings. **Kholisatul Amaliyah** contributed to statistical analysis, data visualization, and interpretation of the results. All authors reviewed, revised, and approved the final version of the manuscript.

CONFLICT OF INTEREST STATEMENT

The authors confirm that there are no conflicts of interest, either financial or personal, that may have influenced the content or outcome of this study.

ETHICAL COMPLIANCE STATEMENT

This manuscript complies with research and publication ethics. The authors affirm that the work is original, conducted with academic integrity, and free from any unethical practices, including plagiarism.

STATEMENT ON THE USE OF AI OR DIGITAL TOOLS IN WRITING

The authors acknowledge the use of digital tools, including AI-based technologies, as support in the research and writing stages of this article. Specifically, Grammarly was employed for correcting writing and grammar errors. All outputs generated with digital assistance were critically evaluated and revised to ensure academic rigor and ethical standards were upheld. The final responsibility for the manuscript rests entirely with the authors.

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