An integrated model of financial technology adoption and environmental performance: The role of green innovation

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ARTICLE INFO	ABSTRACT
	Purpose-This study examines the effect of fintech adoption on environmental performance and analyzes the mediating role of green innovation among Batik MSMEs in Yogyakarta, Indonesia. The study aims to determine whether the use of digital financial tools encourages environmentally oriented innovation and whether such innovation contributes to improved environmental outcomes. **Methodology**-A quantitative approach was employed by surveying 124 Batik MSMEs selected through purposive sampling. Data were analyzed using PLS-SEM to evaluate the direct effects of fintech adoption and the mediating mechanism of green innovation. All constructs were measured using validated indicators adapted from previous studies. **Findings**-The results show that fintech adoption exerts a positive and significant effect on green innovation. However, its influence on environmental performance is positive but insignificant. Green innovation demonstrated a negative and non-significant influence on environmental performance, suggesting that existing innovation efforts have not been able to generate observable environmental gains. As a result, green innovation fails to serve as a mediating mechanism between fintech adoption and environmental performance. **Research Limitations**-The study is limited to Batik MSMEs in Yogyakarta, Indonesia, and uses purposive sampling with self-reported data, which may reduce generalizability. Conceptually, the model includes only fintech adoption, green innovation, and environmental performance, excluding other relevant factors that may influence sustainability outcomes. **Novelty**-This study contributes to the literature by integrating fintech adoption and green innovation within an environmental performance framework specific to traditional creative industries. The findings highlight that fintech adoption may encourage innovation, but such innovation alone is insufficient to improve environmental outcomes, underscoring the need for stronger environmental capabilities and policy support for sustainability in MSMEs.

1. Introduction

Global awareness of environmental degradation continues to increase, encouraging businesses, including micro, small, and medium enterprises (MSMEs), to adopt more sustainable strategies in their operations (Wielgórka, 2016; Anaman et al., 2025). Shifting consumer preferences toward more environmentally friendly products indicate that society is increasingly demanding that industries implement responsible production practices and use resources efficiently (Kosyak & Popov, 2020). In addition, increasing international pressure for sustainability requires companies and MSMEs to integrate green innovation into their business strategies to maintain long-term competitiveness (Khurana et al., 2019; Reniati & Faisal, 2024). In Indonesia, the push for green innovation is growing stronger, in line with government policies and increasing social pressure to ensure that business activities are in line with sustainability principles (Abyan, 2025).

Batik MSMEs in Yogyakarta, Indonesia, constitute a culturally significant sector that contributes substantially to the national economy and preservation of traditional heritage (Kholifah et al., 2024). Yogyakarta is widely recognized as one of the major batik-producing regions in Indonesia, with well-established production centers located in areas such as Giriloyo Subdistrict, Imogiri Subdistrict, Kotagede Subdistrict, and Ngasem Subdistrict. These batik clusters have long maintained traditional production methods while simultaneously facing contemporary challenges related to environmental sustainability, including high levels of chemical usage, wastewater discharge and reliance on conventional production processes. Consequently, improving environmental performance within Yogyakarta's batik industry has become a strategic priority, particularly in the context of increasing global expectations for sustainable and environmentally responsible creative industries. Yogyakarta's status as a World Batik City by the World Craft Council (WCC) further strengthens the strategic position of this sector in the regional creative economy (Wahyudi et al., 2016). However, high batik production activities also pose environmental challenges, particularly the use of chemicals in the dyeing and bleaching processes, as well as liquid waste, which has the potential to pollute the environment if not managed properly (Indrayani & Triwiswara, 2020; Phang et al., 2022). Kusumawardani et al. (2024) showed that most batik MSMEs in Indonesia still use conventional production processes that generate high waste and are inefficient in energy use.

One strategic approach to addressing environmental performance challenges is the use of financial technology (fintech) (Bhuiyan et al., 2024). Fintech is a digital innovation that supports financial services, such as electronic payments, automatic transaction recording, and digital-based financing access (Shahid et al., 2025). The application of fintech in MSMEs addresses capital constraints, low financial inclusion, and operational process inefficiencies (Rahayu et al., 2023; Ismanto et al., 2023). In the context of MSMEs, fintech improves transaction efficiency and strengthens financial management and decision-making capabilities (Rahayu et al., 2023; Hamid et al., 2024). According to Davis (1989), the technology acceptance model (TAM) posits that an individual's intention to use a technology is shaped by how useful they believe the technology to be and how easy it is to operate. This is relevant to Yogyakarta Batik MSMEs, which have begun utilizing various digital services such as e-wallets, QRIS payments, and fintech lending platforms.

From the standpoint of resource-based view (RBV) theory by Barney (1991), fintech represents a valuable digital asset that can enhance MSMEs' abilities to obtain financing, streamline their production activities, and facilitate investment in environmentally sustainable practices. Empirical research supports that fintech accelerates operational digitization and enhances innovation capabilities in MSMEs (Febriyani et al., 2024). Thus, fintech has the potential to play a strategic role in promoting green innovation and improving environmental performance.

However, green innovation is a key strategy for improving environmental performance (Rehman et al., 2021). Green innovation is the innovation carried out by companies in the form of processes, products, or managerial practices designed to reduce environmental impact, improve energy efficiency, and minimize waste (Karabulut & Hatipoğlu, 2020). Green innovation can be explained through ecological modernization theory by Mol and Spaargaren

(2000), which states that technological innovation can reduce environmental impact without hindering economic productivity. Green innovation encompasses efforts to create eco-friendly products, improve process efficiency and implement more sustainable approaches to environmental management (Khan & Johl, 2019). In the batik industry, green innovation can be realized through the use of natural dyes, waste filtration systems, energy-saving technologies, and clean production process design (Kusuma et al., 2023). However, its implementation is often hampered by limited capital, low technological capabilities, and minimal access to green financing (Owen et al., 2018; Chien et al., 2022).

Environmental performance reflects the extent to which an organization can minimize its ecological footprint by reducing waste, improving energy efficiency, adopting eco-friendly materials, and enhancing overall resource management practices (Ali et al., 2019). Theoretically, triple bottom line theory by Elkington (1997) shows that corporate sustainability encompasses three aspects: profit, people and planet. In this context, environmental performance reflects the planet's performance, namely waste reduction, energy efficiency, and the use of environmentally friendly materials. Green innovation has been proven to improve environmental performance through more efficient and less polluting production processes (Weng et al., 2015; Wang, 2019).

There is still a gap in the research conducted, as despite evidence that fintech can improve efficiency and access to financing, very few studies have linked fintech to environmental performance. Most fintech studies have focused on financial efficiency, productivity, and financial inclusion (Ediagbonya & Tioluwani, 2023; Danladi et al., 2023). Theoretically, fintech support can reduce barriers to green innovation financing and accelerate the modernization of production processes (Liu et al., 2023; Li et al., 2024). Furthermore, most studies on green innovation have focused on large-scale manufacturing industries (Ullah et al., 2022; Yang & Zhu, 2022), leaving traditional creative sectors such as batik relatively unexplored. To date, no comprehensive study has examined the combined influence of fintech adoption, green innovation, and environmental performance on Batik MSMEs in Yogyakarta. The batik industry has its own characteristics, such as being labor-intensive and tradition-based, but it also has high environmental pressure. Therefore, an appropriate research approach is needed to explain how the application of fintech can catalyze green innovation. This study is novel in that it integrates fintech and green innovation into a single conceptual framework to understand how environmental performance in the batik industry can be improved.

Building on the research gaps outlined earlier, this study aims to provide a comprehensive examination of how the adoption of fintech shapes sustainability outcomes among Batik MSMEs in Yogyakarta. Specifically, this study investigates the influence of fintech adoption on green innovation and environmental performance, evaluates the direct effect of fintech on environmental outcomes, examines the contribution of green innovation to environmental performance, and tests whether green innovation acts as a mediating pathway between fintech adoption and environmental performance. Through these objectives, this research seeks to generate a more structured and in-depth understanding of how digital financial integration and environmentally oriented innovation support the transition toward sustainable practices within traditional creative industries.

2. Literature Review and Hypothesis Development

RBV theory by Barney (1991) suggests that digital capabilities, including fintech, can function as strategic intangible resources that enhance organizational efficiency and support sustainability goals. Fintech tools, such as mobile banking, e-wallets, and digital lending platforms, expand MSMEs access to capital, streamline financial transactions, and reduce administrative burdens (Desiyanti, 2025). Such efficiency gains enable firms to reallocate resources to environmentally responsible activities. Prior studies show that fintech adoption enhances operational sustainability by reducing transaction inefficiencies and improving resource allocation (Chueca & Ferruz, 2020; Chueca & Ferruz, 2021). Yan et al. (2022) further argue that fintech can reduce ecological footprints by lowering energy-intensive processes. Similarly, empirical studies by Alsadoun and Alrobai (2024) and Yuan (2025) confirm that

fintech adoption positively contributes to corporate sustainability through enhanced resource efficiency, and reduced emissions. These perspectives align with the theoretical claim that fintech can improve environmental performance by supporting cleaner operational practices. **H₁: Financial Technology Adoption Has a Positive Effect on Environmental Performance.**

TAM by Davis (1989) posits that individuals are more likely to adopt a technology when they believe it offers practical benefits and can be operated with minimal effort. In the MSMEs context, fintech adoption enhances access to financing, improves accounting accuracy, and supports better capital management (Dai, 2020; Gunawan et al., 2023). From RBV theory by Barney (1991), fintech represents a strategic resource that enhances a firm's innovation capacity. A growing body of empirical evidence supports this. Al-Okaily et al. (2021) demonstrated that fintech enhances a firm's innovative capacity, including its ability to develop sustainability-focused innovations. Wibowo and Aumeboonsuke (2020) and Ashta (2023) highlight that fintech lending accelerates investment in energy-efficient and environmentally friendly technologies. Manap et al. (2023) similarly concluded that fintech access improves MSMEs' innovation capabilities. Based on these arguments, fintech adoption is expected to stimulate environmentally oriented innovation. **H₂: Financial Technology Adoption Has a Positive Effect on Green Innovation.**

According to Mol and Spaargaren (2000), ecological modernization theory posits that technological upgrading enables firms to reduce environmental impacts while maintaining productivity. Green innovation, which refers to the creation of environmentally responsible products, processes, and managerial practices (Sun et al., 2023), is widely recognized as an essential contributor to sustainability performance. This conceptual view is strongly supported by the empirical evidence. Khan et al. (2021) highlighted that green innovation enhances energy efficiency while lowering waste generation and emissions. Numerous studies have also reported a positive link between green innovation and environmental performance (Kraus et al., 2020; Rehman et al., 2021; Ha et al., 2024). Sun et al. (2023) further demonstrate that improvements in green processes can substantially decrease pollution levels, and similar benefits have been documented across manufacturing industries by Seman et al. (2019), Aftab et al. (2023), and Wang and Yang (2021). Collectively, these findings reinforce the expectation that implementing green innovation contributes to better environmental outcomes. **H₃: Green Innovation Has a Positive Effect on Environmental Performance.**

The RBV theory also supports the argument that green innovation may function as a mediating mechanism, given that fintech operates as a digital resource capable of lowering the financial constraints associated with adopting new innovations. Although fintech may not directly influence environmental performance, it can create enabling conditions that allow firms to engage in environmentally oriented innovation initiatives (Guang-Wen & Siddik, 2023). fintech-supported financing increases the feasibility of adopting cleaner technologies and environmentally friendly processes (Cen & He, 2018). Thus, green innovation is the mechanism through which fintech adoption can translate into better environmental outcomes. Empirical evidence supports this theory. Xu et al. (2022) and Wen et al. (2025) found that digital capabilities promote sustainability primarily through enhanced innovation. Mubarak et al. (2021) demonstrated that digital transformation enhances a firm's capacity for green innovation, which, in turn, contributes to better environmental outcomes. Similarly, Sahoo et al. (2023) and Akhtar et al. (2024) provide evidence that innovation is an intermediary mechanism linking technology adoption to improvements in environmental sustainability. Zhao et al. (2023) similarly demonstrate that technology-enabled sustainable innovation leads to improved environmental outcomes and competitiveness. Based on this reasoning, green innovation is expected to mediate the relationship between fintech adoption and environmental performance. **H₄: Green Innovation Mediates the Relationship between Financial Technology Adoption and Environmental Performance.**

Figure 1 presents the conceptual framework of this study, outlining the proposed relationships among the central variables. The model posits that fintech adoption enhances the capacity of MSMEs to engage in green innovation, which is expected to contribute to improved environmental performance. Beyond its direct influence, green innovation is positioned as an intermediary that transmits the effects of fintech adoption on environmental performance, thereby establishing a more integrated and comprehensive pathway within the research framework.
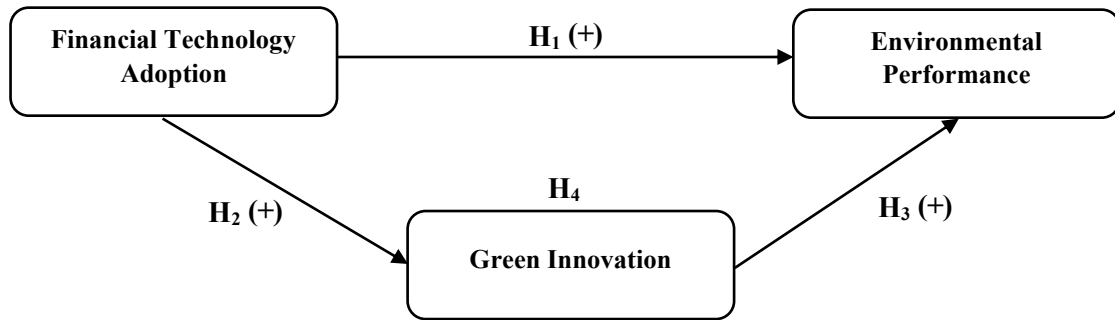

Figure 1. Research Framework

3. Research Methodology

This study employs a quantitative, survey-based design to empirically analyze the linkages among fintech adoption, green innovation, and environmental performance within Batik MSMEs in Yogyakarta, Indonesia. The quantitative approach is considered suitable because this study seeks to test directional hypotheses and assess structural relationships among latent constructs, which aligns with the predictive and explanatory capabilities of partial least square-structural equation model. The population of interest includes all Batik MSMEs operating in Yogyakarta, Indonesia, and a total of 124 businesses were selected through purposive sampling based on predefined criteria that directly support the aims of the study: The owners or managers of batik MSMEs, MSMEs operating for a minimum of two years, MSMEs that actively use financial technology such as mobile banking, e-wallets, or fintech lending, and MSMEs that have implemented or begun adopting environmentally oriented innovation practices. Although purposive sampling does not provide statistical representativeness, it is methodologically justified in studies where the research variables—fintech usage and green innovation—are not uniformly present across the population. To reduce sampling bias, the respondents were drawn from major batik clusters across Yogyakarta, including Giriloyo Subdistrict, Imogiri Subdistrict, Kotagede Subdistrict, and Ngasem Subdistrict, capturing variations in business size, age, and technological capability. However, the use of this sampling approach may constrain the extent to which the results can be generalized to wider MSME populations.

Data were gathered through an online structured questionnaire disseminated via batik MSMEs associations, cluster networks, and other digital communication channels. The instrument utilized a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). All measurement items were adapted from Tian et al. (2023) and other previously validated instruments. The instrument contained eight indicators measuring financial technology adoption, six indicators assessing green innovation, and four indicators evaluating environmental performance. The formulation of the measurement items follows the reflective indicator design commonly used in technology adoption and sustainability studies.

Data analysis was performed using SmartPLS, with validity and reliability tests. Indicators were declared valid if they had a loading factor above 0.7, while construct reliability was assessed using Cronbach's alpha, which must exceed 0.6, and composite reliability which must be above 0.7 (Hair et al., 2020). In addition, convergent validity was evaluated using the average variance extracted (AVE), where an AVE value above 0.5 indicates that the construct explains more than half of the variance of its indicators, in accordance with the criteria

proposed by Hair et al. (2020). Furthermore, hypothesis testing was conducted using the bootstrapping method, and the hypotheses were accepted if the p-value was < 0.05 for both direct and mediating effects. This analytical approach was used to ensure a comprehensive examination of the relationships among financial technology adoption, green innovation, and environmental performance within the sustainability context of Batik MSMEs in Yogyakarta.

4. Result and Discussion
Respondent characteristics

The characteristics of the respondents in Table 1 show that in this study, most of the Batik MSMEs actors in Yogyakarta are women (69%), while men comprise 31% of the total respondents. In terms of age, respondents were dominated by those over 50 years old (57%), followed by those aged 41–50 years (37%), indicating that batik businesses are mostly run by individuals with relatively long experience in the field. The educational level of respondents varied, with the largest proportion being university graduates (42%) and high school/vocational school graduates (38%), while the rest were diploma (18%) and junior high school graduates (17%). Based on business age, the majority of MSMEs have been operating for more than 10 years (57%) and 6–10 years (35%), indicating high business sustainability and stability. With respect to income levels, the largest proportion of respondents reported earning more than IDR 3,000,000 per month (44%), followed by those with monthly earnings between IDR 1,500,001 and IDR 3,000,000 (40%). These findings indicate that the batik MSMEs in Yogyakarta are generally in the middle-income bracket.

Table 1. Characteristics of Respondent

Classification	Description	Frequency	
		Total	Percentage
Gender	Male	38	31
	Female	86	69
Age	21–30 years old	1	1
	31–40 years old	6	5
	41–50 years old	46	37
	> 50 years old	71	57
Education Level	Junior High School	2	2
	Senior/Vocational High School	47	38
	Diploma	23	18
	Bachelor	53	42
Business Age	< 1 year	2	2
	1-5 years	8	6
	6-10 years	43	35
	> 10 years	71	57
Monthly Net Income	< IDR 500.000	3	2
	IDR 500.001 – IDR 1.500.000	17	14
	IDR 1.500.001 – IDR 3.000.000	49	40
	> IDR 3.000.000	55	44

Validity Test

The validity assessment presented in Table 2 and Figure 2 demonstrates that all indicators associated with the constructs of financial technology adoption, green innovation, and environmental performance satisfy the required validity standards. According to Ghozali (2021), an item is deemed valid when its loading factor is greater than 0.7. All measurement items in this study surpassed this threshold, indicating that the instruments exhibited adequate convergent and discriminant validity. Thus, all variables in this study on the effect of FinTech adoption on environmental performance with green innovation as a mediator are declared valid and suitable for use in the next stage of analysis.
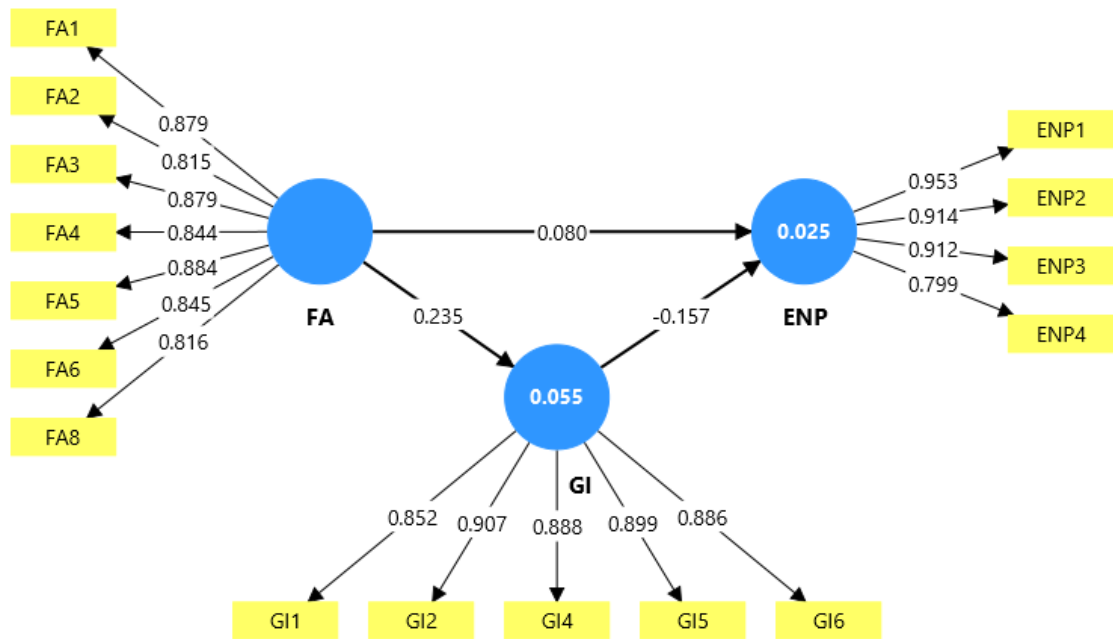
Figure 2. Measurement Framework

Table 2. Validity Test Results

Indicator	Fintech Adoption	Green Innovation	Environmental Performance
FA1	0.879		
FA2	0.815		
FA3	0.879		
FA4	0.844		
FA5	0.844		
FA6	0.845		
FA8	0.816		
GI1		0.852	
GI2		0.907	
GI4		0.888	
GI5		0.899	
GI6		0.886	
ENP1			0.953
ENP2			0.914
ENP3			0.912
ENP4			0.799

Reliability Test

The reliability analysis presented in Table 3 shows that all constructs demonstrate high internal consistency, as evidenced by Cronbach's alpha coefficients greater than 0.9 for fintech adoption, green innovation, and environmental performance. In addition, Cronbach's alpha, which must exceed 0.6, and composite reliability which must be above 0.7, which met the criteria described in the research methodology following Hair et al. (2020). Accordingly, all measurement instruments were considered reliable and valid for further structural analysis.

Table 3. Reliability Test Results

Variable	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
Fintech Adoption	0.937	0.949	0.726
Green Innovation	0.932	0.948	0.786
Environmental Performance	0.917	0.942	0.803

Hypothesis Test

Table 4 reports the results of the hypothesis testing. The results indicate that the adoption of financial technology positively influences green innovation, aligning with the expected direction of the hypothesis. In contrast, the relationship between financial technology adoption and environmental performance, although positive, appears weak, while the association between green innovation and environmental performance is negative, reflecting a direction contrary to the proposed hypothesis. These unsupported relationships can be explained by the small coefficient sizes and p-values exceeding the 0.05 significance threshold, demonstrating that the data do not provide sufficient statistical support for hypothesized effects. Additionally, because green innovation neither enhances nor significantly relates to environmental performance, it cannot operate as a mediating variable in the relationship between fintech adoption and environmental performance. Overall, these results imply that although fintech adoption promotes green innovation, such innovation has not translated into improved environmental performance among MSMEs.

Table 4. Hypothesis Testing Results

Variable	Original Sample	Sample Mean	Standard Deviation	T Statistics	P Values
Fintech Adoption → Environmental Performance	0.043	0.043	0.116	0.371	0.710
Fintech Adoption → Green Innovation	0.235	0.245	0.077	3.043	0.002
Green Innovation → Environmental Performance	-0.157	-0.170	0.095	1.659	0.097
Fintech Adoption → Green Innovation → Environmental Performance	-0.037	-0.040	0.027	1.373	0.170

Discussion

The Effect of Fintech Adoption on Environmental Performance

The results reveal that the adoption of fintech does not significantly impact environmental performance. This outcome implies that the current utilization of fintech among Batik MSMEs remains primarily transactional, focusing on digital payments, bookkeeping efficiency, or cash flow management, rather than being leveraged to support environmentally oriented investments. From the TAM by Davis (1989), this implies that although fintech is perceived as useful for operational efficiency, its perceived usefulness has not been extended to environmental objectives. Likewise, RBV theory by Barney (1991) posits that digital financial tools can serve as strategic resources for sustainability. However, Batik MSMEs appear unable or unwilling to convert fintech-based efficiencies into environmental improvements.

The results of this study contrast with those of Ashta (2023) and Yuan (2025), who demonstrated that fintech adoption enhances energy efficiency and emission reductions in large and digitally mature firms. This discrepancy likely reflects structural differences: unlike corporations with strong environmental capabilities and investment capacity, traditional MSMEs especially in cultural industries like batik face technological, financial, and knowledge barriers that hinder the translation of fintech benefits into environmental outcomes. These findings align with those of Kustiningsih et al. (2022) and Sobar (2025), who argue that digital tools often fail to produce direct environmental benefits in MSMEs because of limited

absorptive capacity. Thus, fintech alone is insufficient to drive measurable environmental improvements in Batik MSMEs in Yogyakarta.

The Effect of Fintech Adoption on Green Innovation

The second result demonstrates that the adoption of fintech positively and significantly enhances green innovation. This reinforces the RBV theory by Barney (1991) assertion that digital financial resources can enhance firms' innovation capabilities. Fintech enables greater accessibility to funding, reduces transaction costs, and improves financial planning, all of which can support environmentally oriented innovation. These findings align with the ecological modernization theory by Mol and Spaargaren (2000), which argues that technological advancement can stimulate ecological progress through innovation-driven mechanisms. This interpretation is further supported by empirical evidence. Halawa et al. (2025), Campanella et al. (2025), and Rahmani et al. (2025) demonstrate that fintech-enabled financing strengthens MSMEs' ability to pursue sustainability-oriented innovations. Similarly, Olagoke et al. (2025) noted that fintech promotes innovation by expanding access to capital and enhancing digital financial literacy. Within the batik MSMEs context, fintech supports the implementation of environmentally oriented innovations, including experimentation with natural dyes, the adoption of more efficient dyeing techniques, and improvements in waste management processes. However, these innovation efforts may still be limited in scale, which is connected to the following findings.

The Effect of Green Innovation on Environmental Performance

The findings indicate that green innovation has a negative and non-significant influence on environmental performance. This suggests that the innovation activities undertaken by Batik MSMEs are still incremental and small-scale and are unable to generate substantial improvements in environmental outcomes. From a triple bottom line perspective by Elkington (1997), current innovation efforts may be driven more by economic efficiency (profit) than environmental stewardship (planet), leading to weak impacts on sustainability. These findings contradict prior studies in larger or more technologically advanced industries, such as Li and Zeng (2020), Wang and Yang (2021), and Aftab et al. (2023), which found strong positive impacts of green innovation on resource efficiency and pollution reduction. Conversely, the results support studies focused on MSMEs, such as Fahad et al. (2022) and Rodrigues and Franco (2023), which argue that MSMEs often face technological and financial barriers that prevent green innovation from yielding significant environmental outcomes. For batik MSMEs, innovations such as switching to natural dyes or improving wastewater filtration may still lack the intensity, consistency, or technological sophistication to produce measurable environmental performance.

Green Innovation Mediates Fintech Adoption and Environmental Performance

The analysis shows that green innovation is not a significant mediator between financial technology adoption and environmental performance. Although fintech adoption successfully enhances green innovation, the innovation itself does not translate into improved environmental outcomes; therefore, an indirect pathway was not established. This indicates that the innovation capability of batik MSMEs remains fragmented and insufficiently mature to function as an effective mechanism linking digital resource adoption with sustainability performance. This result diverges from the findings of Yan et al. (2022), Guang-Wen and Siddik (2023), and Akhtar et al. (2024), who reported that green innovation mediates the relationship between digitalization and sustainability performance in more technologically advanced sectors. Instead, the findings align with those of Thomas et al. (2022) and Dai et al. (2025), who argue that SMEs often engage in low-intensity or symbolic environmental innovations that fail to generate substantive environmental improvements. In the batik industry, characterized by traditional production methods, limited environmental awareness, and cost constraints, innovation efforts are not yet strong enough to mediate the fintech–environment performance relationship.

5. Conclusion

This study found that the adoption of fintech plays a meaningful role in enhancing green innovation within Batik MSMEs in Yogyakarta, Indonesia. This result highlights the importance of digital financial solutions in supporting businesses' ability to pursue environmentally oriented innovative activities. Nonetheless, the lack of significant effects of fintech adoption and green innovation on environmental performance suggests that these innovation initiatives have not yet resulted in observable or measurable improvements in environmental outcomes. The insignificant mediating role of green innovation further suggests that the innovation capabilities of Batik MSMEs remain limited, fragmented and insufficiently integrated within broader sustainability strategies.

Beyond the direct findings, these results highlight several broader implications. Theoretically, this study enriches the discussion on the RBV and ecological modernization theory by showing that the availability of digital resources alone is insufficient to generate sustainability outcomes in traditional craft-based MSMEs. Instead, complementary environmental capabilities and organizational readiness are required. Practically, the findings suggest that MSMEs need stronger environmental management skills, targeted technological assistance, and investment capacity to enable innovation and produce tangible environmental benefits. For policymakers, this study emphasizes the need for integrated programs combining fintech-based financing schemes, environmental training, infrastructure support, and incentives for cleaner production to accelerate sustainability transformation in the batik sector.

Future research should consider expanding the conceptual model by incorporating variables such as environmental capabilities, regulatory pressures, green strategic orientations, and technological readiness. Comparative studies across different regions or creative industry subsectors, along with longitudinal or mixed-method research designs, are also suggested to better capture the evolving interplay between the adoption of digital technology and sustainability outcomes. Incorporating these approaches would allow future research to generate more robust insights into how digital transformation can be integrated more effectively with environmental sustainability practices within MSMEs.

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