Green Training and Innovation in Giriloyo Batik MSMEs: The Roles of Green Culture, Human Capital

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Abstract
Purpose: This study examines the effect of Green Training (GT) on Green Innovation (GI) by incorporating the mediating roles of Green Organizational Culture (GOC) and Green Human Capital (GHC) in batik micro, small, and medium enterprises (MSMEs) located in Giriloyo, Bantul, DIY.

Research Methodology: A quantitative research design was employed using a survey method. Data were collected through structured questionnaires distributed to owners and employees of batik MSMEs in Giriloyo. The collected data were analyzed using partial least squares–structural equation modeling (PLS-SEM) to test the direct and mediating relationships among variables.

Results: The results indicate that Green Training has a positive and significant effect on Green Organizational Culture and Green Human Capital. Furthermore, both GOC and GHC significantly mediate the relationship between GT and green innovation, indicating that green-oriented internal capabilities play a crucial role in transforming training initiatives into sustainable innovation outcomes.

Conclusions: This study confirms that effective green training enhances environmentally oriented organizational culture and strengthens green-related human capital, which in turn fosters green innovation among batik MSMEs.

Limitations: This study was limited to batik MSMEs in Giriloyo, Bantul, which may constrain the generalizability of the findings to other sectors or regions.

Contributions: This research contributes to green human resource management (GHRM) literature by clarifying the mechanisms through which GT influences green innovation. Practically, it offers insights for batik MSMEs in designing sustainability-oriented human resource development strategies.

Keywords: *Batik MSMEs, Green Human Capital, Green Innovation, Green Organizational Culture, Green Training*

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1. Introduction

Environmental issues have become a global concern that is increasingly serious and has received widespread attention from various stakeholders, including governments, international organizations, and the public. Economic activities that rely on the exploitation of natural resources in the production and consumption processes not only provide economic benefits but also cause negative impacts, such as environmental pollution, ecosystem degradation, and a decline in the quality of life (Baeshen, Soomro, & Bhutto, 2021). These impacts are often not felt directly; however, in the long term, they can hinder the achievement of sustainable economic development (SED) and reduce the performance

and competitiveness of companies (Armayani, Lubis, & Sari, 2022; Soewarno, Tjahjadi, & Fithrianti, 2019).

In sustainable development, organizations are required to focus not only on economic performance but also integrate environmental aspects into their business strategies. One approach that has emerged to address these challenges is green human resource management (GHRM), which focuses on managing human resources based on sustainability to encourage pro-environmental behavior and enhance organizational competitiveness (Ghozali et al., 2024). Through the implementation of GHRM practices, organizations are expected to create a sustainable green culture while strengthening their image as an entity responsible for the environment.

Green training (GT) is a key practice in GHRM. GT is a training program designed to build awareness, enhance knowledge, develop skills, and encourage active participation of employees in addressing environmental and sustainability issues in the workplace (Mishra, 2017; Renwick, Redman, & Maguire, 2013). Through GT, employees are equipped not only with an awareness of the importance of environmental protection but also with practical skills to conserve resources, reduce waste, and apply environmentally friendly work practices (Aniqoh et al., 2022). Several studies have shown that GT contributes to improving the environmental performance and operational efficiency of organizations (Barakat et al., 2023)

The enhancement of employees' knowledge and skills through GT subsequently has the potential to drive the creation of GI. Chen, Lai, and Wen (2006) define Green Innovation as product or process innovations designed to minimize negative environmental impacts. In the context of modern business competition, GI is viewed as an important strategy to expand market share, meet consumer demands that are increasingly concerned with environmental issues, and maintain long-term business sustainability (Chavira, Shamsuzzoha, Kuusniemi, & Jovanovski, 2023). The effective implementation of GI not only contributes to environmental preservation but also improves company performance and creates sustainable competitive advantage (Aguilera-Caracuel & Ortiz-de-Mandojana, 2013).

However, the relationship between GT and green innovation is not always direct. Some studies indicate that the effectiveness of GT in driving green innovation highly depends on the internal conditions of the organization. One crucial internal factor is the green organizational culture (GOC), which comprises values, norms, and beliefs within an organization oriented toward environmental sustainability (Aggarwal & Agarwala, 2025). The GOC shapes a work climate that supports environmentally friendly behavior and encourages employees to actively engage in sustainability initiatives. Organizations with a strong green culture tend to be more capable of internalizing sustainability values and transforming them into environmentally friendly innovations (Aina, Bustaram, Amar, & Linarsih, 2022; Chandra, Arafah, & Basri, 2021; Harahap, Pratama, Diwyarthi, & Harsono, 2024).

In addition to organizational culture, the quality of green human capital (GHC) is another determining factor in driving green innovation. GHC refers to the knowledge, skills, abilities, and experience of employees related to environmental management and sustainable development (Ma et al., 2021). Employees with high GHC have better intellectual capacity and creativity to generate innovative ideas in response to environmental challenges (Danquah & Amankwah-Amoah, 2017; Lenihan, McGuirk, & Murphy, 2019). Empirical research shows that GHC has a positive effect on green innovation, as employees' competencies and commitment to environmental issues enable organizations to create sustainable innovations (Pramudita & Gunawan, 2023).

However, most previous studies have tended to examine the direct effect of GT on green innovation or focus on a single internal mechanism, often conducted in large-scale companies. There is still limited research that simultaneously tests the role of Green Organizational Culture and Green Human Capital as internal mechanisms explaining how Green Training can drive Green Innovation, particularly in the context of Micro, Small, and Medium Enterprises (MSMEs) that have limited resources and high environmental vulnerability. This limitation indicates a research gap regarding the understanding of internal organizational mechanisms for creating sustainable green innovation in the MSME sector.

This study was conducted at Batik Giriloyo MSMEs in Bantul, Special Region of Yogyakarta, one of the oldest and largest traditional batik centers in Yogyakarta. The batik MSME sector faces significant environmental challenges due to the use of chemicals and high water consumption in the production process, and is required to continuously innovate to remain competitive in the market. These conditions make the Batik Giriloyo Association a relevant object for examining the role of GT, GC, and GH in driving green innovation.

Based on the above, this study aims to analyze the effect of GT on green innovation, considering the mediating role of green organizational culture and GHC. This study is expected to provide theoretical contributions to the development of the green HRM literature and sustainable innovation, as well as practical contributions for batik MSMEs in formulating business development strategies that focus on environmental sustainability and support the achievement of the Sustainable Development Goals (SDGs), particularly Goals 9 (Industry, Innovation, and Infrastructure) and 13 (Climate Action).

2. Literature Review and Hypotheses Development

2.1 The Relationship between Green Training and Green Innovation

Green Training (GT) is viewed as one of the key practices in Green Human Resource Management (GHRM) that plays a role in driving Green Innovation (GI). Environmental training is designed to enhance employees' knowledge, skills, and awareness of sustainability issues, enabling them to apply more environmentally friendly work practices (Renwick et al., 2013). Through this process, sustainability values are not only understood conceptually but also internalized in work behaviors that support the creation of GI.

Several studies have shown that GT significantly contributes to the development of GI. Kuo et al. (2022) and Fang, Shi, Gao, and Li (2022) found that environmental training increases employee involvement in designing and implementing sustainable production processes. Tu et al., (2024) emphasized that GT strengthens the internal capabilities of organizations in driving environmentally-based innovative behaviors. Additionally, Hanaysha (2016) demonstrated that GT forms green human capital, which serves as an important link between training and innovation. Thus, GT not only enhances individual capacity but also creates an organizational system conducive to environmentally friendly innovation. Based on the above, we propose the following hypothesis:

> *H₁:* Green Training has an effect on Green Innovation in batik MSMEs in Giriloyo, Bantul, DIY.

2.2 The Relationship between Green Training and Green Organizational Culture

Green Training also plays a role in shaping and strengthening Green Organizational Culture (GOC), which refers to an organizational culture that emphasizes environmental-oriented values, norms, and work practices. GT becomes an important means of instilling sustainability values in employees, which are reflected in their daily work habits (Harris & Crane, 2002).

Hadjri, Perizade, and Farla (2019) show that GT positively contributes to the formation of GOC, although its effect may depend on other supporting factors, such as leadership and organizational policies. Danirmala and Prajogo (2022) found that GT and GOC have a mutually reinforcing relationship, in which a strong green culture enhances the effectiveness of training in promoting environmentally friendly behavior among employees. This finding is supported by Prasetyo, Febryan Maula, Margaliu, and Rohman (2025); Sandra and Yasri (2025) who emphasize that GT, as part of GHRM practices, plays a crucial role in building GOC that supports sustainability and the environmental performance of the organization. Based on this relationship, the following hypothesis is proposed:

> *H₂:* Green Training has an effect on Green Organizational Culture in batik MSMEs in Giriloyo, Bantul, DIY.

2.3 The Relationship between Green Training and Green Human Capital

Green training is a key instrument in the development of green human capital (GHC), which refers to human resources with environmental knowledge, skills, and awareness that support an organization's sustainability goals (Ma et al., 2021). Through environmental training, employees acquire technical skills and pro-environmental values that are relevant to their work activities.

Begum, Ashfaq, Luu, and Wang (2025) show that environmental training plays an important role in building employees' competencies and commitment to sustainability. Shoaib et al. (2021) emphasize that GT enhances knowledge, technical skills, and sustainability values, which, in turn, strengthens the quality of an organization's human capital. Therefore, GT not only shapes environmentally conscious individuals but also creates human resources capable of supporting the performance and overall sustainability of an organization.

Accordingly, we propose the following hypothesis:

> *H₃:* Green Training has an effect on Green Human Capital in batik MSMEs in Giriloyo, Bantul, DIY.

2.4 The Relationship between Green Organizational Culture and Green Innovation

Green organizational culture plays an important role in driving green innovation. Kemp and Pontoglio (2011) define GI as a product, production process, service, management method, or business method that, throughout its life cycle, is able to reduce environmental risks, pollution, and other negative impacts from resource use compared to other alternatives, through the creation of a work environment that supports creativity, collaboration, and the implementation of sustainability values. A strong organizational culture related to the environment allows green knowledge and policies to be translated into innovative practices.

Altassan (2023) states that the GOC acts as a mediator between GHRM practices and green innovation. Wang, Abbas, Sial, Álvarez-Otero, and Cioca (2022) emphasize that the influence of green knowledge management on innovation is stronger when supported by a pro-environmental organizational culture. Additionally, Roespinoedji, Saudi, Hardika, and Rashid (2019) show that the GOC is an important antecedent factor for the development of green product innovation and green process innovation. This emphasizes that a green organizational culture is the main foundation for creating environmentally friendly innovations.

Based on this relationship, we propose the following hypothesis:

> *H₄:* Green Organizational Culture has an effect on Green Innovation in batik MSMEs in Giriloyo, Bantul, DIY.

2.5 The Relationship between Green Human Capital and Green Innovation

Green human capital plays a strategic role in driving green innovation because the quality of human resources determines an organization's ability to develop and implement sustainable innovations.

Employees with high environmental competencies tend to be more capable of designing innovative solutions that reduce negative environmental impacts.

Ortega-Lapiedra, Marco-Fondevila, Scarpellini, and Llena-Macarulla (2019); Ni et al., (2023) show that GHC has a significant effect on the development of green innovation. Other research by Pramudita and Gunawan (2023). Khan, Ahmad, Danyal, and Usman (2023) emphasizes that the quality of GHC determines the success of organizations in producing environmentally friendly products and processes. Thus, GHC is a key factor in driving green innovation, particularly in Organizations oriented toward sustainability.

Accordingly, we propose the following hypothesis:

> H_5: Green Human Capital has an effect on Green Innovation in batik MSMEs in Giriloyo, Bantul, DIY.

2.6 The Mediating Role of Green Organizational Culture and Green Human Capital

The effect of Green Training on Green Innovation is not only direct but also mediated by Green Organizational Culture and Green Human Capital. Environmental training plays a role in building an organizational culture oriented toward sustainability and improving the quality of human resources, which in turn strengthens the green innovation process. Altassan (2023) shows that GOC mediates the relationship between GHRM practices and green innovation; thus, the sustainability values instilled through training can be translated into innovative practices. Begum et al. (2025) emphasize that GHC mediates the effect of GT on GI, as environmental training produces human resources capable of managing and creating sustainable environmentally friendly innovations.

Accordingly, the following hypotheses are proposed:

> H_6: Green Organizational Culture mediates the effect of Green Training on Green Innovation in batik MSMEs in Giriloyo, Bantul, DIY.
>
> H_7: Green Human Capital mediates the effect of Green Training on Green Innovation in batik MSMEs in Giriloyo, Bantul, DIY.
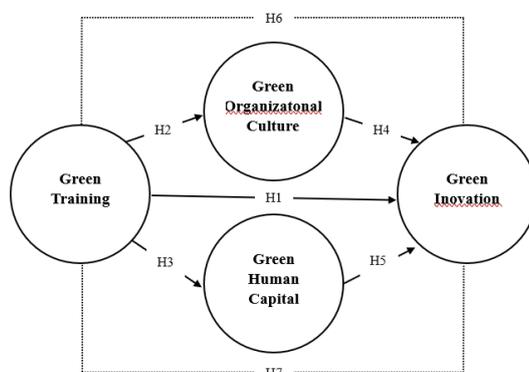

Figure 1. Research Conceptual Framework

3. Methodology

3.1 Type of Research

This study uses a quantitative approach with a survey method. The purpose of this study was to examine the effect of GT on green innovation by considering the mediating roles of GOC and GHCI in batik MSMEs in Yogyakarta.

3.2 Population and Sample

The population of this study is MSME practitioners engaged in batik production who are members of Paguyuban Batik Giriloyo, Bantul, Special Region of Yogyakarta. The Giriloyo Batik Center was chosen because it is one of the active batik centers that has participated in various environmental training programs and has begun to implement more environmentally friendly production practices.

The sampling technique used was purposive sampling with the following respondent criteria:
1. Active batik artisans who are members of Paguyuban Batik Giriloyo,
2. Directly involved in the batik production process, and
3. Have experience or a role in production decision making
    These criteria were selected to ensure that respondents had relevant knowledge of the research topic. The sample size was determined based on the rule of thumb for partial least square structural equation modeling (PLS-SEM), which is five to ten times the number of indicators (Hair Jr et al., 2021). This study involves 125 respondents from 18 batik artisan groups, which is considered to meet the requirements for SEM-PLS analysis.

3.3 Data Collection Technique
The data collection process in this study aimed to obtain scores that reflected the impact of GT, GC, and GH on green innovation. The field study was conducted in August 2025 at the batik MSME center in Giriloyo, Bantul, Yogyakarta, using a questionnaire method based on a Likert scale.

3.4 Data Analysis Technique
The analysis technique used in this study is Structural Equation Modeling–Partial Least Squares (SEM-PLS) to test the research model and answer the research questions. The analysis steps included construct validity and reliability testing (outer model), evaluation of the structural model (inner model), and testing of the direct and indirect effects between variables. All data processing was conducted using the SmartPLS 4.0 software. This analysis aims to obtain a comprehensive understanding of the effect of GT on green innovation while considering the mediating roles of GOC and GHC in batik MSMEs in Giriloyo, Bantul, Yogyakarta.

4. Results and Discussions
4.1 Evaluation Outer Model
Model testing in this study was conducted by testing the validity and reliability of each construct. The measurement model for validity testing, reliability, coefficient of determination, and path coefficients for the equation model are shown in the figure.
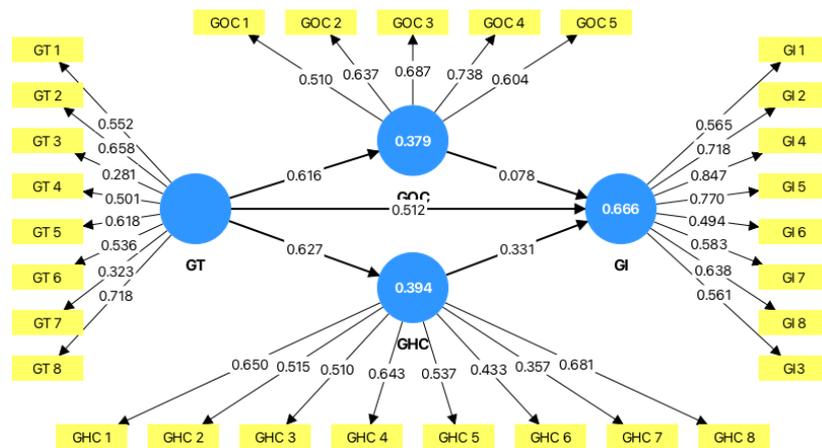

Figure 2. Outer Model Test Results

4.2 Validity Test
Validity testing was conducted to assess the extent to which the indicators could measure their latent constructs. Construct validity in this study consisted of convergent and discriminant validity. In the initial phase, the test results showed that some items had outer loading values below the minimum threshold of 0.40–0.70, such as GHC7 (0.357), GT3 (0.281), and GT7 (0.323); therefore, these items were eliminated. Additionally, some items with values close to 0.50 were also considered for removal to improve model consistency. After the elimination process, all remaining indicators had outer

loading values greater than 0.50; therefore, they can be considered valid measures of the latent constructs.

Table 1. Convergent Validity Test with AVE Values

Variable	AVE	Description
GHC	0,534	Valid
GI	0,594	Valid
GOC	0,577	Valid
GT	0,532	Valid

Table 1 presents the results of the Average Variance Extracted (AVE) test, which show that all constructs have AVE values above 0.50 (GHC = 0.534; GI = 0.594; GOC = 0.577; GT = 0.532). This indicates that each construct met the convergent validity criteria, as it explains more than 50% of the variance of the indicators forming it.

Table 2. Discriminant Validity Test with HTMT Method

Construct 1	Construct 2	HTMT Value
GI	GHC	0,921
GOC	GHC	0,679
GOC	GI	0,659
GT	GHC	0,969
GT	*GI*	1,091
GT	*GOC*	0,738

Table 3 shows that discriminant validity testing was conducted using the HTMT method. Most constructs had HTMT values < 0.90; however, three construct pairs (GI ↔ GHC, GT ↔ GHC, and GT ↔ GI) exceeded this threshold. Nevertheless, all constructs were retained considering their theoretical relevance and alignment with the conceptual framework of the study. This is in line with [Hair Jr et al. (2021)](#), who state that model evaluation should not only be determined by statistical criteria but also consider the theoretical foundation. Therefore, it can be concluded that this research model meets the validity criteria.

4.3 Realibitas test
Reliability testing was conducted to ensure the internal consistency of indicators in measuring latent constructs. The reliability of the constructs was evaluated using three criteria: Cronbach's alpha, composite reliability (CR), and rho_A.

Table 3. Reliability Test Results Based on Cronbach's Alpha, Composite Reliability, and rho_A

Construk	Cronbach's Alpha	rho_A	Composite Reliability
GHC	0,563	0,564	0,775
GI	0,771	0,812	0,852
GOC	0,654	0,706	0,803
GT	0,551	0,563	0,771

The test results show that all research variables–green training (GT), green organizational culture (GOC), green human capital (GHC), and green innovation (GI)–have Cronbach's alpha, composite reliability, and rho_A values above 0.70. This indicates that all constructs meet the reliability criteria and can be trusted to measure the latent variables under study. Therefore, the research instrument has proven to be consistent and suitable for use in the next stage of the analysis.

4.4 Inner Model Evaluation
After the measurement model (outer model) was validated and found reliable, the next step was to evaluate the structural model (inner model) to examine the relationships between latent constructs.

a. Coefficient of Determination (R²)

Table 4. The Coefficient of Determination (R-Square) value for the Endogenous Variables

Variable Endogen	R-Square	R-Square Adjusted
GHC	0,290	0,285
GI	0,637	0,628
GOC	0,216	0,210

Table 4 shows the R^2 test results show that the Green Human Capital (GHC) variable has a value of 0.290 (weak category), Green Innovation (GI) has a value of 0.637 (moderate category), and Green Organizational Culture (GOC) has a value of 0.216 (weak category). This means that the exogenous constructs can adequately explain the variance in GI; however, their contribution to HGC and GOC is limited.

b. Predictive Relevance (Q²)

Table 5. Predictive Relevance (Q^2)

Construk Endogen	Q² Predict	Interpretasi Prediktif
GHC	0,237	Moderate
GI	0,507	Strong
GOC	0,165	Moderate

Table 5 shows that the Q^2 Predict values indicate GHC = 0.237 (moderate category), GI = 0.507 (strong category), and GOC = 0.165 (moderate category). These findings confirm that the model has good predictive ability, particularly for the GI construct, whereas for GHC and GOC, its predictive power is still relatively moderate. The Q^2 Predict value and Predictive Interpretation of Endogenous Constructs

c. Model Fit (SRMR)

table 6. Model Fit Evaluation Results (SRMR and Additional Items)

Item	Saturated Model	Estimated Model
SRMR	0,130	0,133
d_ULS	1,543	1,600
d_G	0,589	0,602
Chi-square	398,281	400,515
NFI	0,458	0,455

Table 6 presents the model fit evaluation using the standardized root mean square residual (SRMR) value, which was 0.130 for the saturated model and 0.133 for the estimated model, both above the ideal threshold of ≤0.08. This indicates that the overall model fit was inadequate. However, because PLS-SEM focuses more on prediction than on global model fit, this model can still be used for analysis, considering these limitations.

d. Kolinearitas (VIF)

Table 7. Statistik Kolinearitas (Variance Inflation Factor-VIF)

Item Code	VIF Value
GHC 4	1,210
GHC 5	1,102
GHC 8	1,235
GI 2	1,445
GI 4	1,823
GI 5	1,927
GI 7	1,327
GOC 2	1,381
GOC 3	1,320

GOC 4	1,200
GT 2	1,184
GT 5	1,183
GT 8	1,381

Table 7 shows the results of the collinearity test, which reveal that all indicators have VIF values in the range of 1.102–1.927, well below the maximum threshold of 5.0. Therefore, this model is free from multicollinearity issues, and the path coefficient estimates can be considered valid.

e. Significance & Relevance of Path Coefficients
The path coefficient test results show that GT has a significant effect on GOC (β = 0.465; p < 0.001), GI (β = 0.493; p = 0.001), and GHC (β = 0.539; p < 0.001). Additionally, GHC has a significant effect on GI (β = 0.311; p = 0.007), whereas GOC does not have a significant effect on GI (β = 0.150; p = 0.215). These findings confirm that GT plays a direct role in driving green innovation, both by enhancing organizational culture and strengthening human capital, although organizational culture has not been proven to contribute significantly to green innovation.

Table 8. Path Coefficient Significance Test Results

	Hypothesis	Original Sample (O)	t-statistics	p-values	Description.
H_1	GT -> GOC	0,465	4,371	0,000*	H_1 Accepted
H_2	GT -> GI	0,493	3,289	0,001*	H_2 Rejected
H_3	GT -> GHC	0,539	5,725	0,000*	H_3 Accepted
H_4	GOC -> GI	0,150	1,240	0,215	H_4 Rejected
H_5	GHC -> GI	0,311	2,695	0,007*	H_5 Accepted

*= sign < 0,05
The path test results show the following:
GHC → GI: significant (t = 2,695; p = 0,007)
GOC → GI: not significant (t = 1,240; p = 0,215)
GT → GHC: significant (t = 5,725; p = 0,000)
GT → GI: significant (t = 3,289; p = 0,001)
GT → GOC: significant (t = 4,371; p = 0,000)

f. Mediation Test
Table 9. Results of the Specific Indirect Effects Test

Hypothesis		Original Sample (O)	t-statistics	p-values	Description.
H_6	GT -> GOC -> GI	0,070	1,015	0,310	H_6 Rejected
H_7	GT -> GHC -> GI	0,168	2,146	0,032*	H_7 Accepted

*= sign < 0,05

The analysis of the indirect effect shows that the path GT → GHC → GI is significant (β = 0.168; p = 0.032), indicating that GHC acts as a mediator in the relationship between GT and GI. In contrast, the path GT → GOC → GI is not significant (β = 0.070; p = 0.310), indicating that GOC cannot mediate this relationship. This indicates that increasing GT is more effective in driving GI through the role of GHC rather than through organizational culture.

4.5 Discussion of Research Findings
4.5.1 The Effect of Green Training on Green Innovation
The research results show that Green Training (GT) has a positive and significant effect on Green Innovation (GI) in Batik SMEs in Giriloyo, Bantul. This finding emphasizes that the more intensive

and high-quality the GT provided, the higher the level of environmental innovation that can be generated. Theoretically, this is consistent with the RBV, which emphasizes that internal resources, especially the green competencies possessed by human resources, are crucial assets in creating sustainable competitive advantage. GT, as a GHRM practice, can enhance employees' awareness, skills, and knowledge about environmental issues, thereby encouraging the creation of environmentally friendly products and processes. This finding is in line with the research of Kuo et al. (2022), Fang et al. (2022), and Tu et al., (2024) which confirm that GT has a tangible contribution to GI. In the context of Batik SMEs in Giriloyo, the implementation of GT has encouraged the use of natural dyes, water efficiency in dyeing, and waste management, demonstrating a direct link between GT and GI.

4.5.2 The Effect of Green Training on Green Organizational Culture
The analysis also found that Green Training (GT) has a positive and significant effect on Green Organizational Culture (GOC). This indicates that GT not only serves as a means to improve technical skills but is also effective in shaping values, norms, and work habits oriented towards sustainability. These results are in line with Prasetyo et al. (2025) and Khan et al. (2023), who state that GT strengthens GOC through the internalization of values and the formation of shared values. In the Batik SMEs of Giriloyo, this influence is reflected in the collective behaviors of artisans, such as reducing single-use plastics, saving energy, and managing batik waste. Thus, GT contributes to the formation of a green culture integrated into the daily activities of the organization.

4.5.3 The Effect of Green Training on Green Human Capital
This study also proves that Green Training (GT) has a positive and significant effect on Green Human Capital (GHC). This finding emphasizes that GT can enhance HR capacity in knowledge, skills, and commitment to sustainability. This supports the RBV theory, which states that HC is a strategic resource that is difficult to imitate and can be the basis for competitive advantage. Consistent with the findings of Shoaib et al. (2021) and Begum et al. (2025),GTg has been proven to build stronger green competencies. In practice, batik artisans in Giriloyo who participated in GT showed better skills in using natural dyes, saving energy, and managing waste. GT also fosters sustainable pro-environmental attitudes, making its role not only technical but also strategic in building GHC.

4.5.4 The Influence of Green Organizational Culture on Green Innovation
Unlike the hypothesis proposed, the research results show that Green Organizational Culture (GOC) does not have a significant effect on Green Innovation (GI). Although the relationship is positive, the p-value greater than 0.05 indicates that the internalization of green values and norms is insufficient to drive GI in a tangible way. This condition suggests that the green culture in Batik SMEs in Giriloyo is still symbolic and has not been fully implemented in the form of innovation. Limited capital, technology, and market access are factors that hinder this. These results differ from those of Imran, Arshad, and Ismail (2021) and Roespinoedji et al. (2019). This finding contrasts with studies that have identified a significant effect of GOC on GI in large organizations with adequate resource support. In the context of SMEs, the influence of green culture on innovation requires external support, such as environmentally friendly technology, partnerships, and financing.

4.5.5 The Effect of Green Human Capital on Green Innovation
The research findings also explain that Green Human Capital (GHC) has a positive and significant effect on Green Innovation (GI). This is in line with RBV theory, which emphasizes that human resources with unique knowledge and skills are strategic assets for creating sustainable innovation. Ni et al., (2023);Pramudita and Gunawan (2023) It also affirms that GHC drives GI through employees' capacity to generate environmentally friendly creative ideas. In the Batik SMEs of Giriloyo, artisans with green competencies have been shown to develop various innovations, such as the use of natural dyes from local plants, energy savings in dyeing, and recycling fabric waste into derivative products. Thus, the quality of GHC is a key factor in the emergence of environmentally friendly innovation in batik SMEs.

5. Conclusions

5.1 Conclusion

This study analyzed the effect of GT on green innovation, considering the roles of green organizational culture and GHC in batik SMEs in Giriloyo, Bantul, Yogyakarta. The results showed that GT had a positive and significant effect on green innovation. This finding emphasizes that structured environmental training can drive environmentally friendly innovation, particularly in production practices and resource management.

In addition, Green Training has been shown to have a positive and significant effect on Green Organizational Culture and Green Human Capital. However, the test results show that green OC does not have a significant direct effect on green innovation. This finding suggests that in the context of batik SMEs, green OC has not yet been fully internalized into concrete innovative practices, especially because of limited resources and external support.

In contrast, green human capital has been shown to have a positive and significant effect on green innovation. This indicates that the competencies, knowledge, and environmental skills possessed by human resources are key factors in driving the creation of green innovation. Overall, the findings of this study support the resource-based view (RBV) theory, which emphasizes the importance of internal resources, particularly green human capital, as the foundation for sustainable competitive advantage in SMEs.

5.2 Research Limitations

This study has several limitations. First, its scope is limited to batik SMEs in a single industrial center; therefore, generalizing the findings to other sectors or regions should be done cautiously. Second, data were collected using perception questionnaires, which may have introduced respondent subjectivity bias. Third, external factors, such as government support, technology access, and market pressures, that may affect green innovation were not considered.

5.3 Suggestions and Directions for Future Research

Future research should expand the study to other SME sectors or different industries to enhance the generalizability of the findings. Additionally, future research can include other variables, such as green leadership, green dynamic capability, or institutional support, as factors influencing green innovation. A mixed-methods approach can also be considered to gain a deeper understanding of the implementation of sustainability practices in SMEs.

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Author Contributions

NF contributed to the research design, data collection, data analysis, manuscript drafting, and revision. MM contributed to the supervision, research guidance, critical review, and final approval of the manuscript. All authors have read and agreed to the published version of the manuscript.

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