

Digitalization as a mediator between green human resource management and sustainable performance in SMEs

A digitalização como mediadora entre a gestão verde de recursos humanos e o desempenho sustentável em PMEs

La digitalización como mediador entre la gestión verde de recursos humanos y el desempeño sostenible en las PYMEs

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Abstract

This study examines the mediating role of digitalization in the relationship between Green Human Resource Management (GHRM) and sustainable performance among small and medium-sized enterprises (SMEs). While previous studies have emphasized the contribution of GHRM to organizational and environmental outcomes, the mechanisms through which GHRM is translated into sustainable performance remain insufficiently explained, particularly in SMEs facing resource and technological constraints. Drawing on the Resource-Based View (RBV) and dynamic capability theory, this study conceptualizes GHRM as a strategic organizational resource and digitalization as a dynamic capability that enables the effective deployment of this resource. A quantitative research

design was employed using survey data from 180 SME owners and managers, which were analyzed through Partial Least Squares Structural Equation Modeling (PLS-SEM). The findings reveal that GHRM has a positive and significant effect on digitalization, and digitalization has a strong positive effect on sustainable performance. However, the direct effect of GHRM on sustainable performance is not statistically significant. These results indicate that digitalization functions as a critical mediating mechanism through which GHRM contributes to sustainable performance. The study advances the literature by demonstrating that GHRM alone may be insufficient to enhance sustainability outcomes unless supported by digital capabilities. Practically, the findings suggest that SMEs should align green human resource practices with digital transformation initiatives to strengthen their economic, environmental, and social performance.

Keywords

GHRM, Digitalization, Sustainable Performance, SMEs, Dynamic Capability, RBV.

Resumo

Este estudo examina o papel mediador da digitalização na relação entre a Gestão de Recursos Humanos Verde (GHRM) e o desempenho sustentável em pequenas e médias empresas (PMEs). Embora estudos anteriores tenham enfatizado a contribuição da GHRM para resultados organizacionais e ambientais, os mecanismos pelos quais a GHRM se traduz em desempenho sustentável permanecem insuficientemente explicados, particularmente em PMEs que enfrentam limitações de recursos e tecnológicas. Com base na Visão Baseada em Recursos (RBV) e na teoria das capacidades dinâmicas, este estudo conceitua a GHRM como um recurso organizacional estratégico e a digitalização como uma capacidade dinâmica que viabiliza a implementação eficaz desse recurso. Foi empregado um delineamento de pesquisa quantitativa utilizando dados de levantamento (survey) com 180 proprietários e gestores de PMEs, analisados por meio da Modelagem de Equações Estruturais com Mínimos Quadrados Parciais (PLS-SEM). Os resultados revelam que a GHRM exerce um efeito positivo e significativo sobre a digitalização, e que a digitalização tem um forte efeito positivo sobre o desempenho sustentável. No entanto, o efeito direto da GHRM no desempenho sustentável não é estatisticamente significativo. Esses resultados indicam que a digitalização atua como um mecanismo mediador crítico pelo qual a GHRM contribui para o desempenho sustentável. O estudo contribui para a literatura ao demonstrar que a GHRM, por si só, pode ser insuficiente para melhorar os resultados de sustentabilidade se não for apoiada por capacidades digitais. Em termos práticos, os achados sugerem que as PMEs devem alinhar as práticas de gestão de recursos humanos verde a iniciativas de transformação digital para fortalecer seu desempenho econômico, ambiental e social.

Palavras-chave

GHRM, Digitalização, Desempenho Sustentável, PMEs, Capacidade Dinâmica, RBV.

Resumen

Este estudio examina el papel mediador de la digitalización en la relación entre la Gestión de Recursos Humanos Verde (GHRM, por sus siglas en inglés) y el desempeño sostenible en las pequeñas y medianas empresas (pymes). Si bien estudios previos han destacado la contribución de la GHRM a los resultados organizacionales y ambientales, los mecanismos mediante los cuales la GHRM se traduce en un desempeño sostenible no han sido suficientemente explicados, especialmente en pymes que enfrentan limitaciones de recursos y tecnológicas. Basándose en la teoría de la visión basada en recursos (RBV) y en la teoría de las capacidades dinámicas, este estudio conceptualiza la GHRM como un recurso organizacional estratégico y la digitalización como una capacidad dinámica que permite el despliegue efectivo de dicho recurso. Se empleó un diseño de investigación cuantitativa utilizando datos de encuestas realizadas a 180 propietarios y gerentes de pymes, los cuales fueron analizados mediante el modelado de ecuaciones estructurales de mínimos cuadrados parciales (PLS-

SEM). Los hallazgos revelan que la GHRM tiene un efecto positivo y significativo en la digitalización, y que la digitalización ejerce un fuerte efecto positivo en el desempeño sostenible. Sin embargo, el efecto directo de la GHRM sobre el desempeño sostenible no es estadísticamente significativo. Estos resultados indican que la digitalización actúa como un mecanismo mediador crítico a través del cual la GHRM contribuye al desempeño sostenible. El estudio aporta a la literatura al demostrar que la GHRM por sí sola puede resultar insuficiente para mejorar los resultados de sostenibilidad si no cuenta con el respaldo de capacidades digitales. Desde una perspectiva práctica, los hallazgos sugieren que las pymes deberían alinear sus prácticas de recursos humanos verdes con iniciativas de transformación digital para fortalecer su desempeño económico, ambiental y social.

Palabras clave

GHRM, Digitalización, Desempeño sostenible, Pymes, Capacidad dinámica, RBV.

1. Introduction

The global transition toward a green economy has intensified organizational pressure to achieve economic competitiveness while simultaneously advancing environmental sustainability. This transition has encouraged managers to integrate sustainability principles into core organizational functions, particularly human resource management and digital transformation (D'Amato *et al.*, 2024; Debnath *et al.*, 2021; Kanda *et al.*, 2025). Within this context, small and medium-sized enterprises (SMEs) occupy a strategic position because of their substantial contribution to employment generation and economic growth, especially in emerging economies (Audretsch & Belitski, 2021; OECD, 2023). However, despite their economic significance, SMEs often face difficulties in translating sustainability commitments into measurable performance outcomes due to resource limitations, restricted technological capabilities, and weak strategic alignment (Omran *et al.*, 2022; Zemtsov *et al.*, 2022).

In response to these challenges, Green Human Resource Management (GHRM) has gained increasing scholarly and managerial attention as a strategic approach for embedding environmental values into organizational routines. Through practices such as green recruitment, green training, performance evaluation, and reward systems, GHRM can shape employee behavior, strengthen environmental awareness, and foster a sustainability-oriented organizational culture (Ren *et al.*, 2021; Yong *et al.*, 2022). Previous studies have consistently shown that GHRM contributes positively to environmental and organizational performance (Dumont *et al.*, 2020; Pham *et al.*, 2022; Yong *et al.*, 2022). Nevertheless, much of this literature tends to assume a direct and linear relationship between GHRM and performance outcomes.

Such an assumption may oversimplify the complex organizational processes through which human resource practices are converted into sustainable performance, particularly in SMEs where

structural and technological constraints can weaken direct effects. At the same time, digitalization has been widely recognized as a key enabler of organizational transformation because it allows firms to improve efficiency, innovation, adaptability, and decision-making capacity (Mariani & Nambisan, 2021; Verhoef *et al.*, 2021; Vial, 2021). For SMEs, digital transformation is not merely a technological upgrade; rather, it represents a strategic capability that can help firms overcome resource constraints and enhance competitiveness (Omrani *et al.*, 2022). More specifically, digital technologies can support the implementation of sustainability practices by improving information processing, monitoring systems, coordination, and evidence-based decision-making (Sharma *et al.*, 2022; Singh *et al.*, 2022).

Despite these developments, several important gaps remain in the literature. First, the mechanisms through which GHRM contributes to sustainable performance are still insufficiently explained. Existing studies have largely emphasized direct relationships and have paid limited attention to the organizational capabilities that may enable or strengthen this relationship, particularly digitalization. Second, prior research often examines GHRM and digitalization as separate streams of inquiry, resulting in a fragmented understanding of how these two strategic elements interact in advancing sustainability outcomes. Third, empirical evidence from SMEs in emerging economies remains limited, even though these firms possess distinct structural characteristics, resource limitations, and transformation challenges (Audretsch & Belitski, 2021; Omrani *et al.*, 2022).

From a theoretical standpoint, these gaps indicate the need to move beyond direct-effect models and adopt a more integrative perspective grounded in the Resource-Based View (RBV) and dynamic capability theory (Barney, 1991; Teece, 2022). RBV emphasizes the importance of valuable, rare, and difficult-to-imitate resources as sources of competitive advantage, but it does not fully explain how such resources are mobilized and deployed in dynamic environments. Dynamic capability theory complements this perspective by explaining how organizations integrate, reconfigure, and transform resources in response to changing conditions (Helfat, 2022; Montalvo-Falcón *et al.*, 2023). In this study, GHRM is therefore conceptualized as a strategic organizational resource, while digitalization is positioned as a dynamic capability that operationalizes, strengthens, and channels the contribution of GHRM toward sustainable performance.

2. Methodology

2.1 Research Design

This study employed a quantitative research approach with a cross-sectional survey design to examine the relationships among Green Human Resource Management (GHRM), digitalization, and

sustainable performance in SMEs. This approach is appropriate because the study seeks to test theoretically derived relationships and hypotheses based on prior literature (J. Hair & Alamer, 2022; Sarstedt, Radomir, *et al.*, 2022). The proposed research model was analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS software. PLS-SEM was selected because it is suitable for analyzing complex models that include mediation effects and is widely applied in management and sustainability research due to its predictive orientation and robustness in studies with medium sample sizes (J. Hair & Alamer, 2022).

2.2 Population and Sample

The population of this study consisted of small and medium-sized enterprises (SMEs) operating in an emerging economy. SMEs were selected because of their significant contribution to economic development and their growing relevance in sustainability and digital transformation research (Kanda *et al.*, 2025; Omrani *et al.*, 2022). A purposive sampling technique was employed to ensure that respondents met the predefined criteria of the study. Eligible SMEs were required to have been operating for at least two years, to have adopted basic digital technologies such as social media or digital platforms, and to have at least one employee responsible for human resource or operational management. A total of 180 valid responses were collected and used for data analysis. This sample size was considered adequate for PLS-SEM analysis and met the recommended criteria for model estimation and hypothesis testing (Sarstedt, Hair, *et al.*, 2022).

2.3 Data Collection Procedure

Data were collected using a structured questionnaire distributed to SME owners and managers. The questionnaire was administered through online platforms and direct distribution to ensure broader respondent coverage and improve the response rate. Before the main data collection process, a pilot test was conducted to assess the clarity, relevance, and reliability of the measurement items. Respondents were informed about the purpose of the study and assured that their responses would remain confidential and anonymous. These procedures were applied to minimize potential response bias and enhance the accuracy and credibility of the collected data (J. F. Hair *et al.*, 2021).

2.4 Measurement of Variables

All constructs in this study were measured using validated scales adapted from prior studies to ensure content validity and reliability. Green Human Resource Management (GHRM) was measured using indicators that reflect green recruitment, green training, green performance

management, and green reward systems (Pham *et al.*, 2020; Ren *et al.*, 2021; Yong *et al.*, 2022). Digitalization was measured based on the extent to which SMEs adopt and utilize digital technologies in their business operations, including digital communication, data management, and process automation (Mariani & Nambisan, 2021; Verhoef *et al.*, 2021; Vial, 2021). Sustainable performance was measured using indicators that capture economic, environmental, and social performance dimensions (Debnath *et al.*, 2021; Kanda *et al.*, 2025; Sharma *et al.*, 2022). All measurement items were assessed using a five-point Likert scale, ranging from 1, indicating strongly disagree, to 5, indicating strongly agree.

2.5 Data Analysis Technique

Data analysis was conducted using SmartPLS by following a two-step analytical procedure consisting of measurement model evaluation and structural model evaluation (J. F. Hair *et al.*, 2021; Sarstedt, Radomir, *et al.*, 2022). The measurement model, or outer model, was assessed to ensure the reliability and validity of the constructs used in the study. This assessment included indicator reliability, internal consistency reliability, convergent validity, and discriminant validity. Indicator reliability was evaluated based on factor loading values of at least 0.70, while internal consistency reliability was assessed using Composite Reliability values of at least 0.70. Convergent validity was examined through the Average Variance Extracted (AVE), with values of 0.50 or higher considered acceptable. Discriminant validity was assessed using the Heterotrait-Monotrait Ratio (HTMT) criterion. These evaluation criteria are widely accepted in PLS-SEM research (Hubona *et al.*, 2021; Sarstedt, Radomir, *et al.*, 2022).

After the measurement model had met the required reliability and validity criteria, the structural model, or inner model, was evaluated to examine the hypothesized relationships among the constructs. The structural model assessment included the analysis of path coefficients, the coefficient of determination (R^2), effect size (f^2), and predictive relevance (Q^2). To test the statistical significance of the hypothesized relationships, a bootstrapping procedure with 5,000 resamples was performed (J. F. Hair *et al.*, 2021). In addition, the mediating effect of digitalization was examined through bootstrapping by assessing the significance of the indirect effect. Mediation was considered supported when the indirect effect was statistically significant (J. Hair & Alamer, 2022; Sarstedt, Radomir, *et al.*, 2022).

2.6 Ethical Considerations

This study was conducted in accordance with standard ethical research practices. Participation was entirely voluntary, and all respondents were informed about the purpose of the study before completing the questionnaire. Respondents were assured that their identities and responses would remain confidential and anonymous. The collected data were used solely for academic purposes and were analyzed in aggregate form to protect respondent privacy.

3. Results

3.1 Measurement Model Evaluation

The measurement model was evaluated to assess the reliability and validity of the constructs used in this study. The results indicate that all indicators met the recommended loading threshold of 0.70, with GHRM indicators ranging from 0.758 to 0.850, digitalization indicators ranging from 0.722 to 0.844, and sustainable performance indicators ranging from 0.774 to 0.887. These results confirm that all retained indicators demonstrated adequate indicator reliability.

Table 1

Measurement Model Assessment

Construct	Loading Range	Cronbach's Alpha	Composite Reliability (rho_a)	Composite Reliability (rho_c)	AVE
GHRM	0.758–0.850	906	912	925	639
Digitalization	0.722–0.844	925	925	938	656
Sustainable Performance	0.774–0.887	936	938	946	663

Source: SmartPLS data processing results, 2026.

As shown in Table 1, all constructs exceeded the recommended threshold for Cronbach's alpha and composite reliability, indicating strong internal consistency. In addition, the Average Variance Extracted (AVE) values for all constructs were above 0.50, confirming convergent validity.

Discriminant validity was assessed using the Fornell-Larcker criterion. The square root of the AVE for each construct was higher than its correlations with other constructs, indicating that each construct was empirically distinct from the others.

Table 2

Fornell-Larcker Criterion

Construct	Digitalization	GHRM	Sustainable Performance
Digitalization	810		
GHRM	728	800	
Sustainable Performance	782	621	814

Source: SmartPLS data processing results, 2026.

Overall, the measurement model results demonstrate that the constructs used in this study have adequate reliability, convergent validity, and discriminant validity. Therefore, the analysis proceeded to the evaluation of the structural model.

3.2 Structural Model Evaluation

The structural model was evaluated using the coefficient of determination (R^2), effect size (f^2), and path coefficient analysis. The R^2 value for digitalization was 0.530, indicating that GHRM explained 53.0% of the variance in digitalization. Meanwhile, the R^2 value for sustainable performance was 0.617, indicating that GHRM and digitalization jointly explained 61.7% of the variance in sustainable performance. These results suggest that the model has moderate to substantial explanatory power.

Table 3

Structural Model Assessment

Endogenous Construct	R^2	Adjusted R^2	Interpretation
Digitalization	530	527	Moderate
Sustainable Performance	617	613	Substantial

Source: SmartPLS data processing results, 2026.

The effect size analysis further shows that GHRM had a large effect on digitalization, with an f^2 value of 1.126. Digitalization also had a large effect on sustainable performance, with an f^2 value of 0.605. However, the direct effect size of GHRM on sustainable performance was very small, with an f^2 value of 0.015. These findings indicate that GHRM contributes more strongly to sustainable performance when it operates through digitalization rather than through a direct pathway.

3.3 Hypothesis Testing

Hypothesis testing was conducted using bootstrapping. The results show that GHRM had a positive and significant effect on digitalization ($\beta = 0.728$, $t = 17.869$, $p < 0.001$), supporting H1. This finding indicates that SMEs with stronger GHRM practices tend to demonstrate higher levels of digitalization.

The direct effect of GHRM on sustainable performance was positive but not statistically significant ($\beta = 0.110$, $t = 1.102$, $p = 0.271$). Therefore, H2 was not supported. This result suggests that GHRM alone may not be sufficient to directly improve sustainable performance in SMEs.

Digitalization had a positive and significant effect on sustainable performance ($\beta = 0.702$, $t = 9.898$, $p < 0.001$), supporting H3. This finding confirms that digitalization plays an important role in improving the economic, environmental, and social performance of SMEs.

Table 4

Direct Effect Results

Hypothesis	Relationship	β	t-value	p-value	Decision
H1	GHRM $\rightarrow$ Digitalization	728	17.869	<0.001	Supported
H2	GHRM $\rightarrow$ Sustainable Performance	110	1.102	271	Not supported
H3	Digitalization $\rightarrow$ Sustainable Performance	702	9.898	<0.001	Supported

Source: SmartPLS data processing results, 2026.

3.4 Mediation Analysis

The mediation analysis shows that the indirect effect of GHRM on sustainable performance through digitalization was positive and significant ($\beta = 0.511$, $t = 8.648$, $p < 0.001$). Therefore, H4 was supported. This finding indicates that digitalization mediates the relationship between GHRM and sustainable performance.

Table 5

Indirect Effect Result

Hypothesis	Relationship	β	t-value	p-value	Decision
H4	GHRM $\rightarrow$ Digitalization $\rightarrow$ Sustainable Performance	511	8.648	<0.001	Supported

Source: SmartPLS data processing results, 2026.

Because the direct effect of GHRM on sustainable performance was not significant, while the indirect effect through digitalization was significant, the results indicate an indirect-only mediation effect. This means that GHRM contributes to sustainable performance primarily through digitalization. In other words, green human resource practices are more likely to produce sustainability outcomes when SMEs are able to integrate them with digital technologies, digital communication systems, data management, and process automation.

4. Discussion

The findings of this study provide important insights into the relationship between Green Human Resource Management (GHRM), digitalization, and sustainable performance in SMEs. The positive and significant effect of GHRM on digitalization indicates that green-oriented human resource practices can strengthen the organizational readiness of SMEs to adopt and utilize digital technologies. This result suggests that digitalization is not merely a matter of technological investment but is also shaped by human resource practices that develop employee awareness, competencies, and adaptive mindsets. From the perspective of the Resource-Based View, GHRM can be understood as a strategic organizational resource that supports competitive advantage (Barney, 1991). Meanwhile, from the perspective of dynamic capability theory, GHRM contributes to the development of organizational readiness to respond to technological and environmental changes (Teece, 2022). Practices such as green training, environmental awareness building, and sustainability-oriented performance management may encourage employees and managers to become more receptive to digital tools that support efficiency, monitoring, coordination, and sustainability-related decision-making.

However, the direct effect of GHRM on sustainable performance was not statistically significant. This finding indicates that although GHRM is theoretically important for promoting sustainability, its influence may not automatically translate into measurable economic, environmental, and social performance outcomes in SMEs. In resource-constrained organizations, green HR practices may remain symbolic or fragmented when they are not supported by adequate systems, technologies, and operational capabilities. This result reinforces the argument that strategic resources alone are insufficient unless they are effectively mobilized and integrated into organizational processes. In line with the Resource-Based View, GHRM may represent a valuable internal resource, but its performance contribution depends on how the organization deploys and combines it with other capabilities (Barney, 1991). Dynamic capability theory further explains this

condition by emphasizing that firms must be able to integrate, reconfigure, and operationalize their resources in response to changing business and sustainability demands (Teece, 2022).

The strong positive effect of digitalization on sustainable performance highlights the central role of digital capabilities in enabling SMEs to improve their sustainability outcomes. Digitalization can enhance sustainable performance by improving operational efficiency, strengthening data management, facilitating communication, supporting process automation, and enabling more accurate decision-making. These functions are particularly important for SMEs because they often face limitations in financial resources, managerial capacity, and formalized organizational systems. Through digital tools, SMEs may be better able to monitor resource use, coordinate internal activities, reduce inefficiencies, and respond more quickly to market and environmental pressures. Therefore, digitalization functions not only as a technological instrument but also as a strategic capability that allows SMEs to transform sustainability intentions into practical organizational outcomes.

The mediation analysis further confirms that digitalization plays a critical role in connecting GHRM with sustainable performance. Since the direct effect of GHRM on sustainable performance was not significant, while the indirect effect through digitalization was significant, the findings indicate an indirect-only mediation effect. This means that GHRM contributes to sustainable performance primarily when it is supported and operationalized through digitalization. In practical terms, green recruitment, green training, environmental performance evaluation, and green reward systems may not be sufficient to improve sustainability outcomes unless they are integrated with digital communication systems, data management, process automation, and technology-based monitoring mechanisms. Thus, digitalization becomes the pathway through which GHRM can be transformed into measurable sustainable performance.

Overall, these findings offer a more nuanced understanding of the GHRM–sustainable performance relationship in SMEs. The study shows that GHRM should not be viewed only as a direct driver of sustainability outcomes, but as a strategic resource whose effectiveness depends on complementary organizational capabilities. Digitalization strengthens the practical implementation of GHRM by enabling SMEs to convert green human resource practices into more efficient, adaptive, and measurable sustainability actions. Theoretically, this finding supports the integration of the Resource-Based View and dynamic capability theory by demonstrating that valuable organizational resources require enabling capabilities to generate performance outcomes. Practically, SMEs should align their green HR practices with digital transformation initiatives so that sustainability values are not only embedded in employee behavior but also institutionalized in organizational systems and daily operational processes.

5. Conclusions

This study concludes that Green Human Resource Management (GHRM) has a positive and significant effect on digitalization, but does not directly produce a significant effect on sustainable performance. Digitalization, however, has a strong positive and significant effect on sustainable performance and plays a critical mediating role in the relationship between GHRM and sustainable performance. These findings indicate that GHRM alone may not be sufficient to improve sustainability outcomes in SMEs unless it is supported by digital capabilities. In this context, digitalization functions as an enabling mechanism that helps translate green human resource practices into measurable economic, environmental, and social performance outcomes.

Theoretically, this study contributes to the literature by integrating the Resource-Based View and dynamic capability theory to explain the GHRM–sustainable performance relationship. GHRM can be understood as a strategic organizational resource, while digitalization represents a dynamic capability that enables SMEs to operationalize and strengthen the value of this resource. The findings therefore suggest that sustainable performance depends not only on the possession of green-oriented human resource practices, but also on the organization’s ability to integrate these practices with digital systems, processes, and capabilities.

5.1 Practical Implications and Future Research

From a practical perspective, SMEs are encouraged to strengthen the alignment between GHRM and digitalization by developing digital competencies, promoting an innovation-oriented culture, and integrating sustainability values into technology-based operational systems. Digitalization should be positioned not merely as a technical tool, but as a strategic instrument for operationalizing GHRM practices and improving sustainable performance. Future research may extend this model by examining other mediating or moderating variables, such as organizational innovation, green innovation, digital maturity, organizational learning, or managerial capability. Further studies may also compare SMEs across different sectors or regions to provide a deeper understanding of how GHRM and digitalization interact in different organizational contexts.

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