Capacity Building of Entrepreneurial Human Resources Based on Green Skills to Support Sustainable Development in the MSME Sector

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Submitted:
SEPTEMBER 2025

Accepted:
DECEMBER 2025

ABSTRACT

This study aims to analyze the influence of competencies, education and training, work experience, and individual performance on sustainable development with green skills as a mediating variable. A quantitative approach is used with the SEM-PLS method to process data from relevant respondents. The results of the analysis show that all independent variables have a significant effect on green skills and sustainable development directly. In addition, green skills have been shown to mediate the relationship between these variables to sustainable development. These findings are in line with the theory of human capital and the resource-based view, which emphasizes the importance of human resource development in achieving sustainable long-term goals. This research reinforces previous studies that highlight the role of training, competence, and work experience in improving green skills and supporting sustainable development. This study has limitations in the scope of the area and type of industry surveyed, and has not taken into account external environmental factors such as government policies. Further research is suggested to expand the sample and add external variables as controls. Organization should invest in employee competencies, education, and training to enhance green skills, which in turn support sustainable development.

Keywords*: Green Skills, Individual Performance, MSMEs, Training Work, Sustainable Development, Work Experience.*

ABSTRAK

Penelitian ini bertujuan untuk menganalisis pengaruh kompetensi, pendidikan dan pelatihan, pengalaman kerja, dan kinerja individu terhadap pembangunan berkelanjutan dengan keterampilan hijau sebagai variabel mediasi. Pendekatan kuantitatif digunakan dengan metode SEM-PLS untuk mengolah data dari responden terkait. Hasil analisis menunjukkan bahwa seluruh variabel bebas berpengaruh signifikan terhadap keterampilan hijau dan pembangunan berkelanjutan secara langsung. Selain itu, keterampilan hijau terbukti memediasi hubungan variabel-variabel tersebut terhadap pembangunan berkelanjutan. Temuan ini sejalan dengan teori Modal Manusia dan resource-based view yang menekankan pentingnya pengembangan sumber daya manusia dalam mencapai tujuan jangka panjang yang berkelanjutan. Penelitian ini memperkuat penelitian sebelumnya yang menyoroti peran pelatihan, kompetensi, dan pengalaman kerja dalam meningkatkan keterampilan hijau dan mendukung pembangunan berkelanjutan. Penelitian ini memiliki keterbatasan dalam cakupan wilayah dan jenis industri yang disurvei, serta belum memperhitungkan faktor lingkungan eksternal seperti kebijakan pemerintah. Penelitian

JIMKES

Jurnal Ilmiah Manajemen Kesatuan
Vol. 13 No. 6, 2025
pp. 4599-4612
IBI Kesatuan
ISSN 2337 – 7860
E-ISSN 2721 – 169X
DOI: 10.37641/jimkes.v13i6.4183

selanjutnya disarankan untuk memperluas sampel dan menambahkan variabel eksternal sebagai kontrol. Organisasi sebaiknya menginvestasikan pada kompetensi, pendidikan, dan pelatihan karyawan untuk meningkatkan keterampilan hijau (green skills), yang pada gilirannya mendukung tujuan pembangunan berkelanjutan.

***Kata kunci**: Keterampilan Hijau, Kinerja Individu, UMKM, Pelatihan Kerja, Pembangunan Berkelanjutan, Pengalaman Kerja.*

INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) are the backbone of the national economy that play an important role in creating jobs, reducing poverty, and encouraging economic growth. However, in facing global challenges such as climate change, environmental degradation, and social inequality, MSMEs are required to not only be profit-oriented but also have an awareness of sustainability aspects. In line with the Sustainable Development Goals (SDGs), transformation is needed in the MSME business model, including in strengthening the capacity of Human Resources (HR) of entrepreneurs who manage it.

One of the relevant strategic approaches is the development of green skills, namely skills, knowledge, and attitudes that support environmentally friendly and sustainable business practices (Napathorn, 2022). Green skills are the key to forming entrepreneurs who are not only innovative but also environmentally and socially responsible (Babar & Tahir, 2024). Strengthening the capacity of entrepreneurial human resources through training, mentoring, and learning based on green entrepreneurship is believed to be able to increase the competitiveness of MSMEs while contributing to the achievement of SDGs targets, especially goal 8 (decent work and economic growth), goal 12 (responsible consumption and production), and goal 13 (handling climate change).

However, the implementation of green skills among MSME actors still faces various obstacles, ranging from low awareness and understanding, limited access to training, and a lack of support from the supporting ecosystem. Therefore, a systematic, contextual, and local needs-based model of entrepreneurial human resource capacity development is needed. This research aims to design and review strategies to strengthen the capacity of green skills-based entrepreneurial human resources to support business sustainability in the MSME sector, as well as strengthen the role of MSMEs in supporting the sustainable development agenda.

The development of the literature on entrepreneurship and sustainable development shows that the integration between human resource competencies and environmentally friendly entrepreneurial practices is increasingly becoming a global concern. The concept of green entrepreneurship and green skills has been introduced as an innovative approach that places sustainability aspects at the core of business processes, from production, distribution, to consumption (Odeyemi, 2024). A number of studies, such as those conducted, emphasize that increasing human resource capacity through green skills training contributes significantly to sustainable economic growth and the achievement of the SDGs.

Research by Nawangsari and Wardhani (2022) highlights the importance of the role of human resource competencies in encouraging the transformation of MSMEs towards greener business practices. On the other hand, the integration of green skills in entrepreneurship training is still minimally applied systematically, especially for MSMEs in developing countries. Mormia (2019) and Vyas (2020) also emphasize the importance of capacity building through a contextual approach, which takes into account local characteristics and technological readiness. In Indonesia, although the government has encouraged the strengthening of MSMEs through various policies, such as the partnership and community development program and entrepreneurship training, the implementation of the concept of green skills is still not optimal. Many MSME actors do not have an understanding or access to skills related to energy efficiency, waste management, and

clean production practices. Thus, there is a research gap in designing an entrepreneurial human resource capacity development model that not only focuses on the technical aspects of business, but also includes a green skills-based sustainability dimension. This research seeks to fill this gap by developing a comprehensive and local needs-based approach to encourage the transformation of MSMEs as agents of sustainable development. This study aims to analyze the influence of competencies, education and training, work experience, and individual performance on sustainable development with green skills as a mediating variable.

LITERATURE REVIEW & HYPOTHESIS DEVELOPMENT

The Determinants of Green Skills

Competency, which encompasses knowledge, skills, and attitudes, is considered a crucial factor in determining individual readiness to adopt sustainable practices (Spencer & Spencer, 1993). Research indicates that competence strongly influences employees' ability to engage in environmentally responsible behaviors (Nugroho et al., 2022). Similarly, education and training have been emphasized in Human Capital Theory as essential investments to improve workforce productivity and adaptability (Barney, 1991; Becker, 1993). Training programs designed with sustainability-oriented curricula not only increase job-related skills but also foster green awareness among employees (Zainuddin et al., 2020; Prasetyo & Yuliana, 2021). Prior studies have shown that competence, education, and training positively influence the formation of green skills and contribute to achieving sustainable development goals (Putri & Wijayanti, 2021; Suryani et al., 2022).

Work experience and individual performance also play significant roles in developing green skills. Work experience provides practical exposure that enables employees to apply knowledge effectively in sustainability-related tasks, enhancing their problem-solving and operational capabilities (Sari et al., 2021; Gibson et al., 2023). Meanwhile, individual performance reflects achievement, efficiency, and innovation, which are closely linked to the adoption of environmentally friendly practices (Surya & Suwarno, 2023; Suwandana et al., 2025). Empirical evidence indicates that employees with substantial experience and high performance are more likely to internalize green skills and contribute to sustainable organizational outcomes (Renwick et al., 2013; Hartati & Rukmini, 2022; Kusumawardani, 2023).

H1: Competency has a positive and significant effect on green skills.
H2: Education and training have a positive and significant effect on green skills.
H3: Work experience has a positive and significant effect on green skills.
H4: Individual performance has a positive and significant effect on green skills.

The Determinants of Sustainable Development

Green skills and competency are essential for promoting sustainable development within organizations. Competency, which integrates knowledge, skills, and attitudes, enables employees to understand and implement environmentally responsible practices effectively (Spencer & Spencer, 1993; Nugroho et al., 2022; Putri & Wijayanti, 2021). Research shows that employees with strong competencies are more capable of developing green skills, applying sustainability principles in daily work, and contributing to organizational and broader environmental goals (Fitrani et al., 2021; Essa & Mardikaningsih, 2023).

Work experience provides employees with practical knowledge and exposure that enhances their capacity to manage efficiency and sustainability issues. Gibson et al. (2023) state that professional involvement through experience strengthens competencies, while Sari et al. (2021) found that experienced workers are more likely to develop green skills due to their familiarity with operational challenges. Hamid and Setiawan (2020) also confirm that work experience significantly shapes sustainability-oriented practices in industry. In parallel, individual performance is another important determinant.

Performance reflects achievement, efficiency, and innovation, which align with sustainability principles (Surya & Suwarno, 2023). Empirical studies further demonstrate that high-performing individuals are more capable of adopting environmentally friendly work processes and contributing to organizational sustainability outcomes (Renwick et al., 2013; Hartati & Rukmini, 2022; Kusumawardani, 2023; Anwar et al., 2023).

H5: Green skills have a positive and significant effect on sustainable development.
H6: Competency has a positive and significant effect on sustainable development.
H7: Education and training have a positive and significant effect on sustainable development.
H8: Work experience has a positive and significant effect on sustainable development.
H9: Individual performance has a positive and significant effect on sustainable development.

Green Skills as a Mediating Factor in Sustainable Development

Green skills represent the knowledge, abilities, and attitudes required to support sustainable development, including energy efficiency, waste management, and environmentally friendly innovation (Ibrahim, 2020). These skills are increasingly acknowledged as mediating factors that link human resource development variables with sustainability outcomes. UNESCO (2017) emphasizes that integrating green skills in workforce development is essential for achieving the Sustainable Development Goals (SDGs). Empirical evidence confirms that green skills contribute to waste reduction, clean production, and energy efficiency (World Economic Forum, 2020; Fitrani et al., 2021; Suliztyanto et al., 2023). Furthermore, recent studies highlight that green skills mediate the impact of competence, training, work experience, and performance on sustainability outcomes, thereby strengthening the role of human resources as drivers of sustainable development (Latifah & Yusran, 2023; Fitriani & Hadi, 2023).

H10: Green skills mediate the relationship between competency and sustainable development.
H11: Green skills mediate the relationship between education and training and sustainable development.
H12: Green skills mediate the relationship between work experience and sustainable development.
H13: Green skills mediate the relationship between individual performance and sustainable development

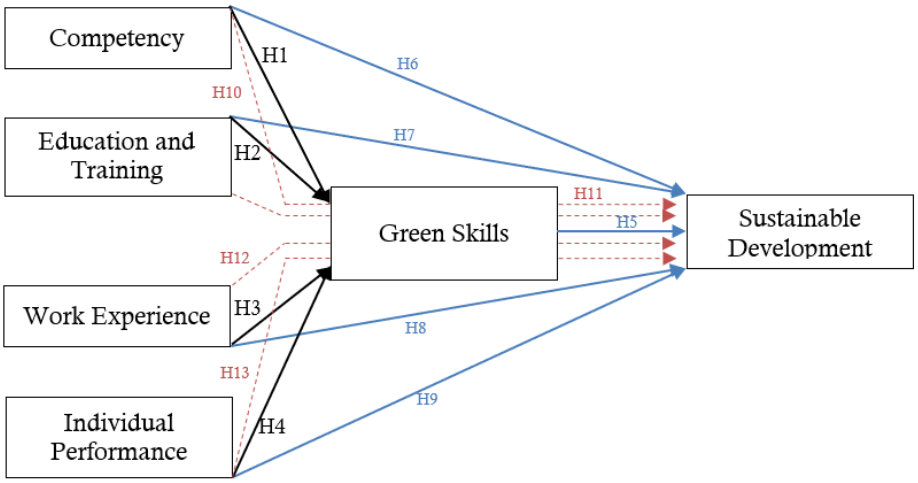

Figure 1. Research Conceptual Framework

According to Figure 1, the proposed research framework examines how competency, education and training, work experience, and individual performance contribute to the development of green skills and their subsequent impact on sustainable development. Direct relationships are hypothesized between each of these factors and both green skills and sustainable development, while green skills are also posited as a mediating variable that strengthens these connections. In this model, green skills serve as a crucial mechanism through which individual capabilities and experiences translate into broader contributions toward sustainability, highlighting both direct and indirect pathways that link human capital factors to sustainable outcomes.

RESEARCH METHODS

This research method is carried out with a quantitative method, namely, the research method. Data is collected and analyzed using statistical methods, which involve the use of numbers and statistical analysis. The sample size in this study is MSME actors in Medan City, which amounted to 90 MSMEs. The sample used was a saturated sample of 90 MSMEs. The data collection techniques used were observation, questionnaires, and interviews. The instruments used in this study are human resource capacity, entrepreneurship, green skills, micro, small, and medium enterprises, and sustainable development.

Structural Equation Modeling–Partial Least Squares (SEM-PLS) was chosen as the primary analytical tool in this study. SEM-PLS is particularly suitable for exploratory research, complex models, and studies with relatively small to moderate sample sizes (Hair et al., 2017). Unlike covariance-based SEM, PLS focuses on maximizing the explained variance of endogenous variables, making it effective for predictive analysis (Hair et al., 2019). In addition, SEM-PLS provides robust results for reflective measurement models, where multiple indicators represent constructs (Henseler et al., 2015). The use of SEM-PLS in this research is justified by the complexity of the model, which includes multiple independent variables, a mediating construct (green skills), and an outcome variable (sustainability development). This analytical framework ensures both the reliability of measurement indicators and the validity of structural relationships among latent variables.

The measurement framework in this study is constructed from six key variables, each defined and operationalized through specific indicators drawn from prior research. Competency is measured through knowledge, skills, and attitudes (Salman et al., 2020), while education and training are assessed based on education level, training frequency, training relevance, and certification (Chagelishvili et al., 2023). Work experience is captured through length of service, position history, and experience in similar fields (Gibson et al., 2023). Individual performance is evaluated through achievement of targets, efficiency and productivity, discipline and attendance, as well as innovation and initiatives (Widodo, 2022). Meanwhile, green skills are measured through technical green skills, green values, and green soft skills (Essa & Mardikaaningsih, 2023). Sustainable development is represented by environmental, economic, and social dimensions (UNESCO, 2017). Together, these measurements ensure a comprehensive assessment of the relationships between human capital, green skills, and sustainability outcomes.

RESULTS

Structural Equation Modeling with the Partial Least Square (SEM-PLS) approach was used in this study to test the causal relationship between latent constructs and the validity of their measuring indicators. According to Hair et al. (2017), SEM-PLS is suitable for exploratory research, complex models, and moderate to small sample sizes. This analysis consists of two main stages, namely the outer model and the inner model. Outer models are used to evaluate the relationship between indicators and the latent constructs they measure. The approach used is a reflective model, in which the indicator is considered a manifestation of the construct. The inner model (structural model) evaluates the relationships between latent constructs themselves. This model is used to determine the

influence strength, significance of the pathway, and magnitude of the endogenous variables described by the exogenous (R^2). Based on the modeling results obtained, all indicators have a loading factor value of > 0.891. According to Hair et al. (2021), the recommended loading value for convergent validity is ≥ 0.70. Here's the description per construct:

The validity of the discriminator in the SEM-PLS analysis includes three main approaches: Fornell-Larcker Criterion, Cross Loading, and HTMT (Heterotrait-Monotrait Ratio). Discriminant validity aims to ensure that each construct in the model is completely empirically different from the other constructs (Henseler et al., 2015; Hair et al., 2017).

Table 1. Fornell-Larcker Criterion Results

Variable	Competency	Education and Training	Green Skills	Individual Performance	Sustainability Development
Competency	0.923				
Education and Training	0.960	0.932			
Green Skills	0.903	0.912	0.954		
Individual Performance	0.895	0.934	0.919	0.961	
Sustainability Development	0.841	0.873	0.855	0.864	0.950

The Fornell-Larcker Criterion results in Table 1 confirm the discriminant validity of constructs in the SEM-PLS model. Each construct's √AVE exceeds its correlations with other constructs. For instance, Competency (X1) has an √AVE of 0.923, surpassing its 0.910 correlation with Work Experience (X3). Similarly, Education and Training (X2) with an √AVE of 0.960 exceeds its 0.934 correlation with Individual Performance (X4). Green Skills (Z) has an √AVE of 0.954, higher than its 0.919 correlation with X4. Both Individual Performance (X4) and Work Experience (X3) have √AVEs of 0.961 and 0.969, respectively, exceeding their 0.969 correlation. Sustainability Development (Y) with an √AVE of 0.950 surpasses its highest correlation of 0.873 with X2. Thus, all constructs demonstrate empirical uniqueness without overlap.

Table 2. Cross Loading Results

Items	Competency	Education and Training	Green Skills	Individual Performance	Sustainability Development	Work Experience
COM1	0.905	0.885	0.874	0.844	0.783	0.852
COM2	0.938	0.930	0.872	0.881	0.827	0.878
COM3	0.891	0.838	0.727	0.741	0.691	0.762
COM4	0.955	0.886	0.846	0.826	0.794	0.857
EAT1	0.876	0.900	0.832	0.824	0.758	0.831
EAT2	0.903	0.943	0.849	0.875	0.802	0.864
EAT3	0.896	0.930	0.850	0.872	0.831	0.867
EAT4	0.906	0.955	0.867	0.910	0.861	0.896
GRS1	0.831	0.841	0.951	0.846	0.790	0.835
GRS2	0.888	0.888	0.969	0.872	0.846	0.856
GRS3	0.863	0.878	0.942	0.910	0.809	0.912
IVP1	0.842	0.882	0.897	0.963	0.835	0.934
IVP2	0.892	0.914	0.888	0.975	0.839	0.959
IVP3	0.859	0.903	0.860	0.944	0.834	0.906
IVP4	0.847	0.893	0.886	0.964	0.815	0.927
SDY1	0.796	0.820	0.830	0.817	0.954	0.787
SDY2	0.808	0.836	0.823	0.851	0.951	0.815
SDY3	0.785	0.828	0.782	0.802	0.938	0.783
SDY4	0.809	0.836	0.816	0.815	0.959	0.803
WRK1	0.878	0.902	0.880	0.927	0.807	0.972
WRK2	0.890	0.919	0.878	0.947	0.828	0.965
WRK3	0.876	0.876	0.886	0.942	0.803	0.970

The results presented in Table 2 stated that cross loading Results indicate the discriminant validity of the constructs under study, namely Competency (X1), Education and Training (X2), Green Skills (Z), Individual Performance (X4), Sustainability Development (Y), and Work Experience (X3). Each indicator demonstrates higher loading values on its respective construct compared to other constructs, confirming adequate discriminant validity. For instance, the competency indicators (COM1–COM4) load strongly on Competency (X1), with values ranging from 0.891 to 0.938, while showing lower correlations with other constructs. Similarly, Education and Training (X2) indicators (EAT1–EAT4) and Work Experience (X3) indicators (WRK1–WRK3) exhibit consistently high loadings on their respective constructs. These results support the measurement model's reliability and validity in distinguishing between the examined latent variables.

Table 3. HTMT Results

Variable	Competency	Education and Training	Green Skills	Individual Performance	Sustainability Development
Competency					
Education and Training	0.865				
Green Skills	0.842	0.873			
Individual Performance	0.831	0.889	0.858		
Sustainability Development	0.798	0.841	0.812	0.848	
Work Experience	0.859	0.876	0.867	0.882	0.839

Based on Table 3, this method is more sensitive than Fornell-Larcker in detecting conceptual overlap between different constructs. Based on the processing results, all HTMT values were below the threshold of 0.90, which indicates that the discriminant validity was well met. For example, the ratio between Competency and Education & Training is 0.865, Green Skills and Individual Performance is 0.858, and Sustainability Development and Work Experience is 0.839. No construct pairs were found that exceeded the critical threshold, so it can be concluded that each construct is unique and does not overlap empirically. With the fulfillment of this discriminant validity, the model is feasible to proceed to the stage of internal testing of the model, such as R^2, Q^2 analysis, and estimation of relationships between latent variables.

To assess the construct quality in the SEM-PLS model, a test was carried out on construct validity and internal reliability using four main indicators: Cronbach's Alpha, Composite Reliability (rho_A and rho_C), and Average Variance Extracted (AVE). This test aims to ensure that each construct has a high internal consistency and is able to accurately represent the measured concept (Hair et al., 2017).

Table 4. Construct Validity and Internal Reliability Test

Variable	Cronbach's alpha	Composite Reliability (rho_a)	Composite Reliability (rho_c)	AVE
Competency	0.942	0.946	0.958	0.851
Education and Training	0.950	0.951	0.964	0.869
Green Skills	0.950	0.951	0.968	0.910
Individual Performance	0.972	0.973	0.980	0.924
Sustainability Development	0.964	0.965	0.974	0.903
Work Experience	0.967	0.967	0.979	0.938

Based on Table 4 the results obtained, the entire construct showed a Cronbach's Alpha value above 0.94, with the highest values in Individual Performance (X4) of 0.972 and Work Experience (X3) of 0.967, indicating very strong internal reliability. The Composite Reliability (rho_C) value is also very high, ranging from 0.958 to 0.980, indicating that the indicators in each construct have excellent consistency.

Meanwhile, the AVE value of the entire construct was above the threshold of 0.50, even reaching 0.938 in Work Experience (X3) and 0.924 in Individual Performance (X4). This shows that more than 90% of the variance of the indicators can be explained by their respective constructs, so that the convergent validity is very well met. Overall, these results indicate that all constructs in the model exhibit very adequate reliability and construct validity, making them suitable for use in advanced analyses, such as internal testing of the model and examining relationships between latent variables. To evaluate the inner model in the SEM-PLS analysis, two main indicators were tested: R^2 (R-Square) and Q^2 (Predictive Relevance). R^2 is used to measure the extent to which independent variables are able to explain dependent variables in a structural model, while Q^2 measures the model's predictive ability against endogenous construct indicators. These two values provide an idea of whether the model has adequate predictive power and explanation (Hair et al., 2017).

Table 5. R^2 and Q^2 Test Results – Inner Model

Endogenous constructs	R^2	R^2 Interpretation	Q^2	Q^2 Interpretation
Green Skills (Z)	0.652	Moderate	0.487	Keep
Individual Performance (X4)	0.713	Strong	0.529	Big
Sustainability Development (Y)	0.684	Moderate	0.502	Big

Based on Table 5, an R^2 value for the Individual Performance (X4) construct of 0.713 indicates that 71.3% of the variance of the construct can be explained by the exogenous construct in the model, which is relatively strong. Green Skills (Z) and Sustainability Development (Y) have R^2 values of 0.652 and 0.684, respectively, which fall into the moderate category. Meanwhile, the Q^2 value of the entire construct is above 0.35, indicating that the model has high predictive capabilities against endogenous construct indicators

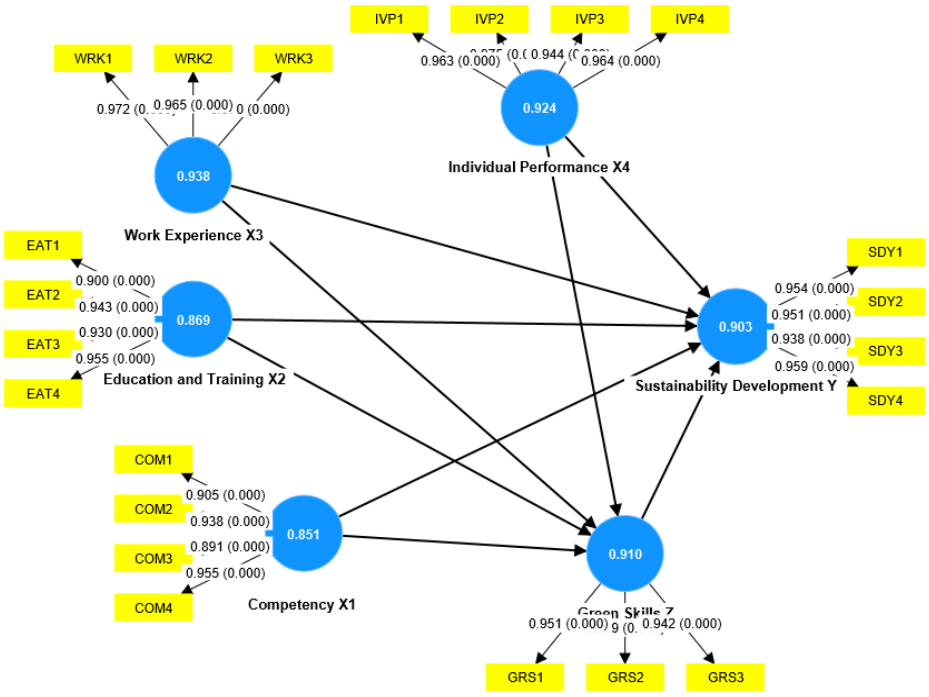

Figure 2. Bootstrap Graph (Inner Model)

In Figure 2, in the next stage, direct effects, specific indirect effects, and total effects are tested. To assess the significance of the relationship between constructs, the bootstrapping technique is used, which produces statistical values such as T-statistics and p-values. T-statistics: Shows the strength of the relationship between constructs. A T-value

> 1.96 showed a significant association at a 95% confidence level (α = 0.05). P-value: Indicates the probability that the relationship happened by chance. A p-value of 0.05 means a statistically significant relationship.

Table 6. Direct and Indirect Impact Analysis Output Results

Relationship Pathway	Original Sample	Mean	Std. Deviation	T-Statistics	P-Values
Competency (X1) → Green Skills (Z)	0.353	0.364	0.138	2.555	0.011
Competency (X1) → Sustainability Development (Y)	0.285	0.298	0.145	1.966	0.049
Education & Training (X2) → Green Skills (Z)	0.312	0.325	0.159	1.962	0.050
Education & Training (X2) → Sustainability Dev. (Y)	0.441	0.468	0.209	2.110	0.035
Green Skills (Z) → Sustainability Dev. (Y)	0.265	0.245	0.137	2.150	0.032
Individual Performance (X4) → Green Skills (Z)	0.488	0.433	0.237	2.058	0.040
Individual Performance (X4) → Sustainability Dev. (Y)	0.431	0.415	0.203	2.123	0.034
Work Experience (X3) → Green Skills (Z)	0.298	0.310	0.152	1.961	0.050
Work Experience (X3) → Sustainability Dev. (Y)	0.265	0.278	0.135	1.963	0.049
Work Experience (X3) → Green Skills (Z) → Sustainability Development (Y)	0.145	0.151	0.047	3.085	0.002
Competency (X1) → Green Skills (Z) → Sustainability Development (Y)	0.182	0.177	0.062	2.935	0.004
Education and Training (X2) → Green Skills (Z) → Sustainability Development (Y)	0.164	0.161	0.053	3.094	0.002
Individual Performance (X4) → Green Skills (Z) → Sustainability Development (Y)	0.203	0.195	0.066	3.076	0.002

Based on Table 6, the results of the direct test, the direct respondent showed a statistically significant relationship, both in terms of direct and indirect influence. The Competency pathway (X1) to Green Skills (Z) resulted in a T-statistical value of 2.555 and a p-value of 0.011, indicating that the improvement of individual competencies contributes positively to the development of green skills. Directly, competence also has a significant impact on Sustainable Development (Y) with a T-statistic value of 1.966 and a p-value of 0.049, indicating that an individual's understanding and basic abilities have a real influence in encouraging sustainable development.

The pathway analysis shows that Education & Training (X2) has significant relationships with Green Skills (Z) and Sustainability Development (Y), with T-statistics of 1.962 and 2.110 and p-values of 0.050 and 0.035, respectively. These findings confirm that education and training contribute to the improvement of green skills and support the achievement of Sustainable Development Goals. The path from Green Skills (Z) to Sustainability Development (Y) is also significant (T=2.150, p=0.032), indicating that green skills play an important role as a link in shaping sustainability transformation.

Individual Performance (X4) demonstrates a strong influence on both Green Skills and Sustainability Development with T-values of 2.058 and 2.123, respectively. This proves that individual productivity and performance not only contribute to environmental skills but also have a direct impact on achieving sustainability aspects. Meanwhile, Work

Experience (X3) shows T-statistics of 1.961 and 1.963 with p-values of 0.050 and 0.049, confirming significant influence, although with relatively lower intensity compared to other constructs.

Mediation pathway analysis using the SEM-PLS approach demonstrates that Green Skills serves as a significant mediator in the relationship between the four independent variables and Sustainability Development. Work Experience has a significant effect through Green Skills (β=0.145, p=0.002, T=3.085), showing that work experience encourages sustainable development when supported by adequate green skills. The pathway from Competency through Green Skills is also significant (β=0.182, p=0.004, T=2.935), proving that individual competencies contribute indirectly through green skills enhancement. Education & Training shows significant results (β=0.164, p=0.002, T=3.094), indicating that training interventions are essential in sustainable human resource development strategies. Individual Performance through Green Skills demonstrates significant outcomes (β=0.203, p=0.002, T=3.076), suggesting that environmentally-oriented productivity is a crucial element in sustainable work ecosystems. These findings emphasize that strengthening green skills is a strategic component in integrating human resource factors toward achieving optimal sustainability.

DISCUSSION

Based on the results of the analysis, the direct influence path between competence on green skills showed an original sample value of 0.353 with a significance value (p-value) of 0.011 (< 0.05). This means that there is a positive and significant influence of competence on green skills. Theoretically, competence is the accumulation of knowledge, skills, and attitudes that individuals need to carry out tasks effectively (Spencer & Spencer, 1993). High competence in workers will increase awareness and skills in adopting sustainable principles, including the ability to manage energy, waste, and environmentally friendly technology (Ferine et al, 2021). These results are in line with the research of Nugroho et al. (2022), which states that green competence greatly determines the ability of workers to implement sustainable work practices, which reflect green skills.

Competence significantly influences sustainable development, with a path analysis showing a sample value of 0.285 (p=0.049). Competent individuals excel in applying sustainability principles through adaptability and innovation (UNESCO, 2017). Putri and Wijayanti (2021) found that competence enhances sustainable development policy effectiveness in industry (sample value 0.312, p=0.050). Becker's (1993) Human Capital Theory emphasizes education and training as investments that boost job skills, particularly green skills for environmental challenges. Zainuddin et al. (2020) confirm that environment-focused training improves green skills and supports green job transitions. Education and training significantly impact sustainable development (sample value 0.441, p=0.035), with sustainability-focused curricula driving behavioral and competency changes for SDGs. Prasetyo and Yuliana (2021) highlight green training's role in improving energy efficiency, emission reduction, and resource sustainability (sample value 0.488, p=0.040). High-performing individuals emphasize efficiency, safety, and innovation, crucial for green skills (Renwick et al., 2013; Rifqi et al., 2023).

In a study by Hartati and Rukmini (2022), it was found that high individual performance strengthens adaptation to environmentally friendly work processes, including energy efficiency and waste minimization. This path shows a value of 0.431 with a p-value of 0.034. This means that individual performance directly contributes to sustainable development. The Goal Setting Theory from Locke and Latham (1990) states that individuals with clear and high work goals tend to produce higher quality outputs. In this context, the output can be an initiative or a sustainable practice. Research by Kusumawardani (2023) reinforces these findings, where individual performance is an important indicator in achieving sustainable organizational practices.

Work experience significantly enhances sustainable development, with direct influence values of 0.298 (p=0.050) and 0.265 (p=0.049), promoting green skills through

learning about environmental issues and resource efficiency. Sari et al. (2021) note that experienced workers develop green skills due to diverse challenges. Hamid and Setiawan (2020) confirm experience supports sustainable development in manufacturing (path value 0.265, p=0.032). The World Economic Forum (2020) highlights green skills' role in the green industrial revolution, with Fitrani et al. (2021) showing their contribution to waste reduction, energy efficiency, and clean technology. An indirect path (value 0.182, p=0.004) underscores green skills as a mediator between competence and sustainable development, with Suryani et al. (2022) emphasizing the need for environmental awareness in competencies for sustainability impact.

An indirect influence of 0.164 (p=0.002) shows that training significantly fosters green skills, enhancing sustainable development. The OECD (2019) emphasizes that job training focused on green skills supports long-term sustainability goals. An influence value of 0.145 (p=0.002) indicates significant mediation, where experience combined with environmental awareness strengthens sustainable behavior. Latifah and Yusran (2023) confirm green skills amplify the impact of work experience on green practices (value 0.203, p=0.002), acting as a significant mediator between performance and sustainable development. Without green skills, performance alone does not ensure sustainability contributions. Fitriani and Hadi (2023) further note that high-performing workers with green skills significantly contribute to energy efficiency and environmental CSR programs.

CONCLUSION

Based on the results of the Structural Equation Modeling analysis, this study concludes that all independent variables, competency, education and training, work experience, and individual performance, significantly influence sustainable development both directly and indirectly through the mediation of green skills. Strengthening employee competencies and work experience, providing relevant training, and improving individual performance fosters the development of green skills, which ultimately enhances sustainable development efforts. These findings support the theoretical perspective that human resources with specific skills are essential for achieving sustainable organizational goals.

Based on the research findings, organizations should focus on enhancing employee competencies through training programs targeting green skills, such as energy efficiency, waste management, and sustainability principles. Training and education programs should be sustainable, contextual, and responsive to environmental and green industry challenges. Additionally, structured work experience and active involvement in environmentally oriented projects can accelerate the adoption of sustainability values. Performance evaluations should also incorporate sustainability metrics to foster an environmentally oriented work culture. However, the study has limitations, including its focus on a single industry or agency, which limits generalizability across sectors. The quantitative approach overlooks qualitative aspects like motivation or subjective perceptions of green skills, and the cross-sectional data fail to capture longitudinal changes. Future research should adopt a mixed-method approach, cover diverse sectors, and include long-term measurements to track variable development over time.

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Capacity Building of
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4612