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The Influence of Green Brand Innovation on Green Brand Loyalty: The Role of Mediating the Value of Green Perception and Green Knowledge

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ABSTRACT

The electronics sector's swift expansion has led to mounting environmental challenges, especially due to the surge in electronic waste (e-waste). This research explores how innovations in eco-friendly branding impact loyalty towards green brands, focusing on environmentally aware Generation Z and millennial consumers in Indonesia. Employing a quantitative causal design, the study gathered data via an online survey completed by 300 participants. The SEM-PLS was utilized for analysis. The findings reveal that innovations in green branding significantly influence consumers' loyalty to environmentally friendly brands. These mediators partially explain how sustainable innovation, combined with effective communication of environmental benefits, strengthens consumer loyalty to green brands. These results underscore the importance of developing environmentally responsible branding strategies and educating consumers about sustainable practices. The study provides theoretical and practical insights for marketers in the electronics industry to foster long-term consumer relationships through green innovation.

Keywords: green brand innovation, green brand loyalty, green perceived value, green knowledge, SEM-PLS

Introduction

The rapid development of technology in today's digital era has brought about a major transformation in almost all aspects of human life. One of the most affected sectors is the electronics industry, which has now become an integral part of modern society's life. Electronic devices such as televisions, refrigerators, washing machines, computers, and other smart devices have now become basic needs. Technology not only provides convenience and efficiency in daily activities, but also encourages economic growth through increased production and consumption of electronics (edubirdie.com, 2022).

However, behind the immense benefits of technology and electronics, there are significant environmental challenges. The relatively short life cycle of electronic products leads to an increase in *e-*

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waste. This type of waste contains dangerous substances like lead, mercury, and cadmium that, if not handled correctly, may pollute the soil and water sources. In Indonesia, based on data from the Ministry of Environment and Forestry (MoEF) in 2021, there are an estimated 2 million tons of e-waste, but only 17.4% is managed appropriately (sdppi.kominfo.go.id, 2023).

Predictions from waste4change show that the amount of e-waste in Indonesia could reach 3,200 kilotons by 2040. This is in line with the increasing consumption of electronic devices due to technological advances and modern lifestyles. This waste consists not only of large devices such as washing machines or televisions, but also small devices such as cables, batteries, and mobile phones. Unfortunately, the majority of this waste is still mixed with household waste and has not been processed according to B3 waste standards (mutucertification.com, 2024).

Awareness of the environmental impact of e-waste is starting to increase, especially among the younger generation such as Gen Z and millennials. Based on the databoks survey (2024), waste management is the second largest environmental issue faced by Indonesia according to the younger generation. However, waste management in Indonesia still has many challenges, where only about 43% of the 41 million tons of waste landfill per year are successfully handled properly (kabarsdgs.com, 2022).

Modern consumers are becoming more aware and attentive to where products come from and how they are made. In the context of electronics, this is shown by the increasing interest in environmentally friendly products. Based on the databoks report (2022), more than 56% of young consumers choose to buy environmentally friendly products. Despite increased awareness, barriers such as lack of information and environmental literacy still stand in the way of fully sustainable consumption (liputan6.com) behavior.

To address this issue, the Indonesian government enacted Government Regulation No. 27 of 2020 on the Management of Specific Waste (PPPSS), which includes the regulation of electronic waste. This policy regulates the mechanism for restricting, reusing, and handling electronic waste, including Initiatives to promote the right to repair aim to extend product lifespans and minimize the production of electronic waste (pslh.ugm.ac.id, 2022).

The electronics industry itself has begun to respond to this challenge by developing more environmentally friendly products. Companies such as Samsung, LG, Panasonic, and Sharp have announced sustainable global strategies that include emission reduction, the use of recycled materials, and waste management programs. These measures show that green innovation is not only a moral choice, but also a promising business strategy amid the demands of increasingly environmentally conscious consumers (topbrand-award.com, 2023).

In the field of marketing, the green marketing strategy has gained significant relevance. It involves creating and promoting products and business practices that are environmentally sustainable and responsible. This approach not only enhances a company's reputation but also fosters greater consumer loyalty toward brands that consistently show a dedication to sustainability (Dangelico and Vocalelli, 2017; Polonsky, 1994).

Companies that manage to build a positive perception of environmental value and knowledge in the eyes of consumers have a great opportunity to strengthen loyalty. This goal can be achieved by driving green brand innovation, increasing the perceived environmental value of products, and delivering educational efforts that elevate consumers' green knowledge. These three elements have been proven to significantly impact green brand loyalty (Han et al., 2019; Chen and Chang, 2013; Dabija, 2018).

Hence, examining how green brand innovation influences brand loyalty while accounting for the mediating effects of green perceived value and green knowledge is crucial. The green electronics sector not only addresses environmental issues but also offers businesses a chance to build lasting

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connections with their customers. This research is expected to make a theoretical and practical contribution to the development of sustainable marketing strategies in Indonesia.

Research Methodology

Drawing from the background, it is clear that the increasing use of electronic products poses a considerable environmental threat, largely driven by the surge in electronic waste. While young consumers are becoming more environmentally conscious, their commitment to eco-friendly electronics remains relatively weak. The primary goal is to examine the causal relationships at play, following the conceptual framework outlined by Bougie (in Indrawati, 2015), this research is a systematic process to find solutions to green management and marketing problems through a thorough analysis of all the causative factors.

Data was gathered by distributing online questionnaires to Generation Z and millennial consumers in Indonesia who have purchased eco-friendly electronic products. The collected data was then analyzed using the SEM-PLS method. This approach was selected for its ability to effectively evaluate both direct and indirect relationships among latent variables and to measure the strength of each pathway within the model. Using this approach, the research aims to provide practical insights for developing sustainable marketing strategies in the electronics sector and to enhance consumer loyalty to green brands.

Data Collection

In this research, data collection involved the use of both primary and secondary sources. The primary data were obtained firsthand by the researchers through online surveys designed with Google Forms, which were then shared across various social media channels. The respondents were Generation Y and Z consumers who had purchased environmentally friendly electronic products. Meanwhile, secondary data was sourced from relevant literature, academic journals, and online materials to support the theoretical framework and discussion (Hardani et al., 2020). The initial step in analyzing the data involved using descriptive statistics to capture the essential features of the gathered information. This process encompassed calculating central tendency indicators. Together, these statistics offered a comprehensive snapshot of how participants responded to the different variable indicators (Hinton et al., 2014; Hardani, 2020).

The SEM-PLS method was utilized to analyze the relationships among latent variables within the research model. This approach was selected because it is capable of analyzing unobservable variables (latent constructs) and can handle measurement errors effectively (Sholihin & Ratmono, 2020). SEM-PLS comprises two main components. The SEM-PLS process includes several key steps: developing a conceptual framework, selecting an appropriate algorithm, choosing a sampling technique, creating a research roadmap, and conducting an overall model evaluation (Ghozali, 2021).

Hasil dan Pembahasan

Convergent Validity

Convergent validity is assessed by calculating the AVE, with a value above 0.5 indicating acceptable validity. When the AVE exceeds this threshold, it means the measurement meets the criteria for convergent validity (Indrawati, 2015). According to Jalu et al. (2023), the latent constructs explain more than 50% of the variance in their related measurement indicators. In this study, the validity test was conducted using the entire research sample, namely 300 samples, showing that all statement indicators were declared valid, that each statement item was valid and had qualified for further analysis and was relevant to this study. According to Ghozali (2021), individual indicators with correlation values above 0.7 are considered valid.

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Table 1
Variable Indicators of Green Brand Innovation and Outer Loading Value

Variabel	Item in Research	Code	Outer Loading
Green Brand Innovation (X) (Lin et al, 2017)	The brand provides effective solutions for customers' eco-friendly needs	GBI1	0.787
	Customers can rely on this brand to offer new solutions to their eco-friendly needs.	GBI2	0.760
	The brand is able to provide new solutions to customers' eco-friendly needs.	GBI3	0.841
	The brand meets the eco-friendly needs of customers.	GBI4	0.823
Green Perceived Value (Z1) (Lin et al, 2017)	The environmental function of this brand provides excellent value for me.	GPV1	0.875
	The brand is eco-friendly	GPV2	0.868
	This brand has more environmental benefits than other brands.	GPV3	0.906
	This brand has more concern for the environment than other brands	GPV4	0.912
Green Knowledge (Z2) Source: (Lin et al, 2017)	I know that I am buying products and packages that are safe for the environment.	GK1	0.888
	I know how to choose products and packages that reduce the amount of waste ending up in landfills.	GK2	0.873
	I understand environmental phrases and symbols on product packaging.	GK3	0.915
	I am very knowledgeable about environmental issues.	GK4	0.916
Green Brand Loyalty (Y) (Lin et al, 2017)	I am willing to buy this brand back because of its environmental function.	GBL1	0.850
	I prefer to buy this brand over other brands because it is eco-friendly.	GBL2	0.790
	I rarely consider switching to another brand because of this brand's concern for the environment.	GBL3	0.828
	I intend to continue buying this brand because it is eco-friendly	GBL4	0.851

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Validity and reliability tests

Table 2
Cronbach's Alpha, Composite Reliability, and AVE Values for Green Brand Innovation Variables

Variabel	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Green Brand Innovation	0.816	0.879	0.645
Green Perceived Value	0.913	0.939	0.689
Green Knowledge	0.920	0.943	0.806
Green Brand Loyalty	0.849	0.898	0.793

A value of Average Variance Extracted (AVE) is deemed acceptable when it surpasses the threshold of 0.5, signifying that the measurement achieves the standard for convergent validity (Indrawati, 2015). Referring to the research data presented above, all AVE values for the indicators 0.645, 0.689, 0.806, and 0.793 exceed this benchmark, confirming their validity.

Reliability testing aims to determine the consistency of a variable. This test assesses how stable the questionnaire results are by examining whether repeated measurements (Komara, 2023).

To assess reliability, Ghozali (2021) tell that a composite reliability score ranging from 0.6 to 0.7 reflects acceptable reliability, while Cronbach's alpha values are ideally above 0 to confirm consistency (Ghozali & Latan, 2015).

In summary, the findings indicate that the variables exhibit discriminant validity, evidenced by multiple correlations. The results verifies that these variables are clearly differentiated from each other, thereby reinforcing the validity.

Table 3 Fornell-Larcker Criterion Results for Discriminant Validity Between Variables

	Green Brand Innovation	Green Brand Loyalty	Green Knowledge	Green Perceived Value
Green Brand Innovation	0.803			
Green Brand Loyalty	0.724	0.830		
Green Knowledge	0.608	0.715	0.898	
Green Perceived Value	0.679	0.761	0.695	0.890

The table above shows data based on the square root of the AVE values. Because these AVE values exceed the correlations with other variables, the research model meets the requirements of the Fornell-

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Larcker Criterion, indicating that all latent variables have greater values than their correlations with other constructs.

Table 4 Results of Cross Loading between Variables for Discriminant Validity Test

	Green Brand Innovation	Green Brand Loyalty	Green Knowledge	Green Perceived Value
Green Brand Innovation				
Green Brand Loyalty	0.868			
Green Knowledge	0.699	0.809		
Green Perceived Value	0.779	0.863	0.753	

HTMT can also be used to test discriminant validity. It calculates correlations to more accurately evaluate discriminant validity and addresses the limitations. HTMT represents the average of all indicator correlations between different constructs. To confirm discriminant validity between two reflective constructs (Henseler et al., 2015). Based on the HTMT value in the research table above, indicates that this research variable is valid.

Inner Model

The internal model evaluation was performed through bootstrapping using SmartPLS.. The R-Square serves as an indicator of the predictive accuracy of the research model, with thresholds of 0.75 indicating a good model, 0.5 representing strength, and 0.25 reflecting a weak (Ghozali, 2021).

Table 5 R Square and R Square Adjusted Values for Endogenous Variables

Variabel	R Square	R Square Adjusted	Keterangan
Green Perceived Value	0.461	0.459	Moderate
Green Knowledge	0.369	0.367	Moderate
Green Brand Loyalty	0.696	0.693	High

Tabel 5 shows the strength of the relationship between the actual observed data and the values predicted by the model. A higher R^2 means the model does a better job at explaining or forecasting the behavior of the dependent variable (Hair et al., 2022). Analysis the research model successfully captures the relationships between green brand innovation and its three dependent variable. Specifically, the green perceived value variable has 0.461, meaning that 46.1% of the variance in consumers' environmental value perceptions can be attributed to green brand innovation. Although this falls into the moderate range, it suggests that green brand innovation significantly contributes to fostering positive consumer perceptions regarding the environmental value of a brand.

Meanwhile, in the green knowledge variable, 0.369 shows that 36.9% of the variation in consumer knowledge about environmentally friendly products can be explained by green brand innovation. Just like before, this value is also classified as moderate, which indicates that eco-friendly brand innovation also plays a role in increasing consumer understanding and awareness of green products, although the influence of other factors is also quite large

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Unlike the other two variables, green brand loyalty exhibited the highest value at 0.696. This is 69.6% of the variation in environmentally focused brand loyalty is explained by green brand innovation, 30.4% is affected by other factors. Falling into the high category, this value implies that consumers tend to show stronger loyalty toward brands that consistently prioritize and implement eco-friendly innovations.

Overall, these results show that green brand innovation so crusial role in make consumer opinion, knowledge, and loyalty to sustainability-oriented brands. Although there are other factors that also influence, this model has a fairly good predictive ability in explaining the three dependent variables studied.

Predictive relevance evaluates the independent variables tells the variation in the dependent variables. The Q^2 metric functions as a measure of the model's capability to accurately forecast data points that were excluded during the model's parameter estimation phase (Hair et al., 2021). When the Q^2 value exceeds zero, it demonstrates that the model can reliably predict new data (Ghozali, 2021).

Table 6 Q^2 (Predictive Relevance) Values for Each Variable

Variabel	Q^2 (=1-SSE/SSO)
Green Brand Innovation	
Green Perceived Value	0.360
Green Knowledge	0.295
Green Brand Loyalty	0.473

The Q Square results shown above, the values for each variable are 0.360 for green perceived value, 0.295 for green knowledge, and 0.473 for green brand loyalty. Since all three values are good than 0, so that the predictive relevance of this study demonstrates strong predictive capability compared to models that do not generate predictions (Hair et al., 2021).

Indirect Effect

Table7

Hipotesis	Original Sample (O)	Sample Mean (M)	Standard Deviasi (STDEV)	T statistic	P Values	Keterangan
Green Brand Innovation → Green Perceived Value → Green Brand Loyalty	0.242	0.246	0.046	5.242	0.000	Diterima
Green Brand Innovation → Green Knowledge → Green Brand Loyalty	0.169	0.168	0.040	4.234	0.000	Diterima

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The analysis aimed to explore how innovations in environmentally friendly branding influence customer loyalty toward green brands, with the effect being channeled through the perceived value that consumers assign to these brands. The results demonstrated a strong and statistically meaningful relationship, showing that green brand innovation not only has a direct positive impact on loyalty but also enhances it indirectly by increasing the perceived value consumers associate with the brand. This confirms that the introduction of green innovations effectively strengthens customer commitment to environmentally conscious brands through both direct engagement and the enhancement of value perception. This relationship is classified as partial mediation, meaning that while green brand innovation continues to directly influence brand loyalty, this effect is further enhanced by consumers' perception of the brand's environmental value.

Theoretically, these results support the understanding that the perception of environmental value formed by a brand's eco-friendly innovation is one of the important determinants in building consumer loyalty. Consumers who highly value the environmental contribution of a product tend to have a stronger emotional and cognitive connection to the brand. Innovation that clearly shows a commitment to sustainability creates a positive perception that then encourages loyalty. Therefore, companies need to continue to develop innovations that are not only functional but also highlight sustainability values as part of their long-term brand strategy.

The study examined how Green Brand Innovation influences Green Brand Loyalty by considering Green Knowledge as a mediator in this relationship. The findings revealed a statistically significant connection, indicating that green knowledge plays a crucial role in strengthening the effect of green brand innovation on loyalty. While green brand innovation alone directly enhances customer loyalty, this impact becomes even more pronounced when consumers have a deeper awareness and understanding of environmental sustainability. In essence, green knowledge acts as a bridge that partially channels and amplifies the positive influence of innovative green branding on consumer loyalty.

Consumer knowledge about sustainability aspects, such as the use of environmentally friendly materials, green production processes, and long-term benefits for the environment, contributes to shaping consumer attachment to brands. When innovations carried out by companies are successfully communicated effectively so as to increase consumer knowledge, then consumers will have a stronger rational reason to show loyalty to the brand. Therefore, these results emphasize the importance of transparent and structured education and information delivery regarding green innovation efforts as part of the strategy to build consumer loyalty in the long term.

Conclusion

Based on the overall findings of this study, it can be concluded that green brand innovation is a key factor in fostering consumer loyalty toward products in the environmentally friendly electronics industry. This finding corroborates the opinion of Ernawarti (2020) who states that *green brand loyalty* is not only formed from consumer satisfaction, but also from the perception of value and trust in brand commitment to environmental sustainability. Innovations carried out by companies, when able to reflect ecological responsibility, will foster positive perceptions and strengthen consumers' emotional connection with the brand.

In addition to the direct influence, the study found that both green perceived value and green knowledge act as mediating factors linking green brand innovation to green brand loyalty. This result is consistent with the perspective of Chen and Chang (2013), who suggested that consumers who appreciate and acknowledge the environmental advantages of a product are more likely to develop loyalty to the brand. Therefore, companies need to develop innovations that are not only environmentally friendly, but also communicated effectively to build positive understanding and

perception among consumers. This strategy is key in creating long-term loyalty in a market that is increasingly concerned about sustainability.

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