

How eco-badges shape online purchase decisions: the roles of perceived diagnosticity and label credibility

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Abstract

Purpose – This study aims to investigate the influence of eco-badges on consumers' purchase decisions within information-dense e-commerce environments in Indonesia. It focuses on perceived diagnosticity as a central cognitive mechanism and label credibility as a key moderating factor, to better understand how sustainability signals affect consumer behavior amid information overload and skepticism about green claims.

Design/methodology/approach – This study employs an explanatory quantitative research design grounded in signaling theory, the heuristic-systematic processing model and source credibility theory. Data were collected through an online survey distributed via social media and e-commerce user communities, resulting in 200 valid responses from millennial consumers actively engaging with e-commerce platforms across multiple regions in Indonesia. The proposed conceptual model was tested using consistent partial least squares structural equation modeling (PLSc-SEM) with ADANCO software to assess the relationships among eco-badges, perceived diagnosticity, label credibility and purchase decision.

Findings – The results reveal that eco-badges, perceived diagnosticity and label credibility each have a positive and significant impact on consumers' purchase decisions. Perceived diagnosticity emerged as the strongest predictor, indicating that consumers prioritize sustainability information perceived as useful and capable of reducing uncertainty over heuristic cues like eco-badges alone. Additionally, label credibility significantly moderates the effects of both eco-badges and perceived diagnosticity, underscoring the crucial role of credible certification sources in enhancing the effectiveness of sustainability signals in e-commerce environments marked by skepticism toward green claims.

Research limitations/implications – This study has several limitations that offer directions for future research. First, the sample size of 200 millennial consumers, while adequate for the analysis, may limit the generalizability of the findings to broader or more diverse consumer segments. Future studies could include larger and more varied samples, including different age groups and geographic regions, to enhance external validity. Second, the cross-sectional design restricts the ability to draw causal inferences. Longitudinal or experimental research could better capture the dynamics of consumer responses to eco-badges and sustainability information over time. Third, the focus on millennial consumers in Indonesia may not fully capture cultural or regional variations in perceptions of eco-badges, diagnosticity, and credibility; comparative studies across countries could address this gap. Practically, the findings suggest that e-commerce platforms should prioritize providing clear, diagnostic sustainability information backed by credible certification to effectively influence purchase decisions. Simply displaying eco-badges without supporting credible and detailed information may not sufficiently alleviate consumer skepticism, especially in markets where greenwashing is a concern. Future research could explore how emerging verification technologies and product category differences impact consumer trust and behavior in online marketplaces.

Practical implications – The findings of this study offer valuable guidance for e-commerce platforms, marketers and sustainability certification bodies. First, platforms should move beyond merely displaying eco-badges as symbolic cues and focus on providing clear, detailed and easily accessible sustainability information that consumers perceive as diagnostic and useful. This approach can help reduce consumer uncertainty and enhance decision-making confidence in information-rich online environments. Second, establishing and prominently showcasing credible certification sources is crucial. Label credibility significantly strengthens the



impact of eco-badges and diagnostic information, helping to counteract consumer skepticism toward green claims and potential greenwashing. Marketers and certification bodies should collaborate to ensure transparency and build trust through rigorous verification processes and clear communication. Finally, these insights highlight the importance of tailoring sustainability communication strategies to consumer segments, particularly millennials who are active e-commerce users. By integrating credible, diagnostic sustainability signals into the user experience, businesses can better engage environmentally conscious consumers and foster more sustainable purchasing behaviors in digital marketplaces.

Social implications – This study underscores the growing importance of transparent and credible sustainability communication in shaping consumer behavior within digital marketplaces. By enhancing the visibility and trustworthiness of eco-labels and sustainability information, e-commerce platforms can empower consumers to make more informed and environmentally responsible purchasing decisions. This, in turn, supports broader societal goals of reducing environmental impact and promoting sustainable consumption patterns. Moreover, the emphasis on credible certification helps combat the pervasive issue of greenwashing, which can erode public trust and hinder collective efforts toward sustainability. Strengthening consumer confidence through reliable sustainability signals fosters a culture of accountability among producers and retailers, encouraging more ethical business practices. Finally, by engaging millennial consumers – who represent a significant and influential demographic – this research highlights the potential for digital commerce to serve as a platform for social change, where informed consumer choices can drive demand for greener products and ultimately contribute to advancing global sustainability agendas such as the United Nations Sustainable Development Goals.

Originality/value – This study contributes to the literature by uniquely integrating perceived diagnosticity and label credibility into the understanding of how eco-badges influence consumer purchase decisions in information-dense e-commerce environments. While previous research has often focused on eco-labels as isolated signals, this research highlights the critical moderating role of label credibility and positions perceived diagnosticity as the central cognitive mechanism driving sustainable consumption choices.

Keywords Eco-badges, Perceived diagnosticity, Label credibility, Purchase decision, e-commerce

Paper type Research article

Introduction

The rapid growth of e-commerce has fundamentally transformed how consumers access, process, and evaluate product information, including information related to sustainability attributes. In Indonesia, e-commerce has emerged as a central pillar of the digital economy, with transaction values being projected to have reached IDR 487.01 trillion in 2024, driven by increasing internet penetration and the intensification of online shopping activities (Statista, 2024). While this development substantially expands consumer choice, it simultaneously creates an information-dense digital environment in which consumers are exposed to numerous competing marketing claims under conditions of limited attention and cognitive capacity. Within this digital context, visual sustainability cues—such as eco-badges—are increasingly used by online retailers to communicate environmental attributes and influence consumers' purchase decisions. As online retail platforms increasingly mediate consumer access to sustainability information, understanding how visual sustainability cues influence purchase decision-making has become a central focus in contemporary retailing research (Herbes *et al.*, 2020).

Within this increasingly complex digital marketplace, sustainability has become a salient element of contemporary marketing strategies. Many e-commerce platforms in Indonesia display visual sustainability symbols, such as eco-badges, on product pages to signal environmentally friendly attributes. These eco-badges are strategically positioned alongside prices, consumer reviews, and promotional messages, enabling them to act as salient visual cues that assist consumers to simplify product evaluations and decision-making in online environments (Donato and Adigüzel, 2022; Majer *et al.*, 2022). However, the mere presence of eco-badges does not automatically ensure effective sustainability communication. In online environments characterized by limited direct verification and heightened exposure to greenwashing practices, consumers frequently exhibit skepticism toward the credibility of environmental claims conveyed through digital symbols. Consequently, understanding the cognitive processes through which consumers interpret eco-badges and translate them into purchase decisions becomes increasingly important in e-commerce research.

From the perspective of signaling theory, sustainability symbols can be conceptualized as external signals employed by producers or sellers to reduce information irregularity between informed parties and consumers possessing relatively less information (Connelly *et al.*, 2011; Spence, 1973). Environmentally friendly attributes are typically classified as credence attributes, which remain difficult to verify even after consumption. As a result, external signals such as eco-badges play a crucial role in shaping consumers' initial perceptions of a product's environmental quality and performance. Prior research demonstrates that eco-labels and sustainability symbols can enhance perceived quality, product evaluations, and purchase intentions (Gomes *et al.*, 2023; Macchione Saes *et al.*, 2025). Nevertheless, existing studies emphasize that the effectiveness of sustainability signals – including eco-labels and visual branding cues – critically depends on how consumers perceive, interpret, and evaluate this information, particularly in relation to factors such as trust and label credibility, which in turn influence the use and impact of these signals in consumer decision-making (Gorton *et al.*, 2021; Ketkaew and Komsing, 2025; Majer *et al.*, 2022).

In information-dense e-commerce environments, consumers do not consistently process all available information in a systematic manner. Information processing theory and the heuristic–systematic model suggest time constraints and cognitive limitations encourage consumers to rely on heuristic processing, using easily recognizable peripheral cues as the basis for decision-making (Chaiken, 1980; Petty and Cacioppo, 1986). Similarly, within the cue utilization framework when intrinsic product attributes are difficult to assess, consumers depend on extrinsic cues – such as icons, labels, and visual symbols – to infer product quality (Jacoby *et al.*, 1971). In this context, eco-badges function as heuristic visual cues that enable consumers to form rapid inferences about product sustainability in e-commerce settings. Empirical evidence supports the influential role of visual cues in shaping perceived quality, product evaluations, and purchase intentions in digital environments (Baek *et al.*, 2023; Chu *et al.*, 2025; Rosillo-Díaz *et al.*, 2024).

However, not all visual cues are perceived to be equally useful or informative. Perceived diagnosticity refers to the extent to which information is regarded as relevant, useful, and capable of assisting consumers in evaluating product alternatives. In the context of eco-badges, perceived diagnosticity reflects consumers' beliefs that the information conveyed by the badge reduces uncertainty and provides a meaningful basis for a purchase decision. Although perceived diagnosticity has been widely examined in information adoption research, empirical studies that explicitly investigate its role as a cognitive mechanism in processing sustainability-related visual cues in e-commerce contexts remain limited (Jiang *et al.*, 2021). In particular, little is known about whether eco-badges influence purchase decisions because they are visually present or because the information conveyed through these badges is perceived by consumers as diagnostically useful when evaluating environmentally friendly products.

Beyond the perceived usefulness of information, the effectiveness of eco-badges is also strongly shaped by the credibility of the label source. Source credibility theory posits that messages are more persuasive when their sources are perceived as knowledgeable, reliable, and trustworthy (Hovland and Weiss, 1951). In sustainable marketing contexts, label credibility plays a critical role in fostering consumer trust and mitigating skepticism toward environmental claims, as credible eco-labels and organic certification labels have been shown to enhance consumers' trust and increase their intentions to purchase environmentally friendly products (Cai *et al.*, 2017; Yang *et al.*, 2024). In e-commerce environments characterized by limited direct verification, label credibility may operate as a boundary condition determining whether eco-badges and related sustainability information are processed or discounted as valid signals by consumers. Thus, label credibility may strengthen or weaken the influence of perceived diagnosticity on consumers' purchase decisions in online retail environments.

Despite the growing body of literature on eco-labels and sustainability cues in digital commerce, most prior studies conceptualize eco-labels as static informational attributes and focus primarily on their direct effects on purchase intentions or product evaluations (Gomes

et al., 2023; Herbes *et al.*, 2020; Macchione Saes *et al.*, 2025). Such approaches offer limited insight into how and under what conditions sustainability-related visual cues are cognitively processed in information-dense e-commerce environments. Moreover, empirical research that simultaneously integrates perceived diagnosticity as an explanatory mechanism and label credibility as a boundary condition remains scarce, particularly in online contexts marked by increasing skepticism toward sustainability claims (Cai *et al.*, 2017; Yang *et al.*, 2024). This limitation is especially evident in emerging markets, where digital retail environments are expanding rapidly but consumer trust in sustainability claims may be more fragile due to varying regulatory standards and the prevalence of greenwashing practices.

Importantly, although prior studies have examined eco-labels, perceived diagnosticity, and individual label credibility, these constructs have rarely been integrated into a single explanatory framework that captures the cognitive mechanisms underlying the processing of sustainability cues in e-commerce environments. As a result, the existing literature provides limited theoretical understanding of how eco-badges influence purchase decisions through consumers' evaluation of information usefulness while simultaneously considering the credibility of the label source. The proposed research model therefore does not simply introduce new constructs but instead offers a theoretically integrative perspective not empirically tested in prior research. Specifically, this study positions perceived diagnosticity as a central cognitive mechanism explaining how consumers interpret eco-badges, while label credibility is conceptualized as a moderating boundary condition that determines the extent to which these sustainability signals translate into purchase decisions in information-dense e-commerce environments.

This study offers several contributions. First, it extends the eco-label and sustainability signaling literature by introducing perceived diagnosticity as a key cognitive mechanism that explains how eco-badges influence purchase decisions in e-commerce contexts. Second, it integrates label credibility as a moderating boundary condition that determines the strength of this relationship, thereby clarifying when sustainability cues are more likely to be trusted and utilized by consumers. Third, by focusing on millennial consumers in Indonesia as a rapidly growing, emerging e-commerce market, this study provides empirical evidence from a context where sustainability communication, digital retail expansion, and consumer skepticism toward environmental claims intersect.

The novelty of this study lies in explicitly explaining how eco-badges influence purchase decision through consumers' perceived diagnosticity of sustainability information, rather than treating eco-badges as static informational cues. This study therefore proposes and empirically tests a mechanism–boundary framework explaining how eco-badges influence purchase decisions through perceived diagnosticity while being conditioned by label credibility. Unlike previous research in emerging markets examining eco-labels primarily as direct predictors of purchase intention, this research develops and tests an integrated model linking eco-badges, perceived diagnosticity, label credibility, and purchase decision within a unified theoretical framework. This study contributes to retailing and consumer services literature by explaining how and under what conditions sustainability cues embedded in online retail interfaces translate into consumer purchase decisions. In addition, this study positions label credibility as a moderating boundary condition that determines the effectiveness of eco-badges and diagnostic sustainability information in e-commerce decision-making. By integrating signaling, heuristic processing, and source credibility perspectives into a single empirical model, this research provides a clear and testable explanation of sustainability-related cognitive processing in information-dense e-commerce environments.

Theoretical background and hypotheses development

Conceptual positioning of sustainability cues in E-commerce

In contemporary e-commerce environments, sustainability-related information is increasingly communicated through simplified visual markers, such as eco-badges. In this study, eco-

badges are defined as visual sustainability indicators displayed on product pages that signal environmentally friendly attributes, certifications, or sustainability commitments of a product to consumers in online retail environments (Atkinson and Rosenthal, 2014; Taufique *et al.*, 2017). Rather than conceptualizing eco-badges as static sustainability labels, this study positions them as conditional heuristic signals whose effectiveness depends on consumers' cognitive evaluation of information usefulness and trust in the label source credibility. This conceptualization responds to recent sustainability marketing and digital consumption literature that advocates moving beyond binary questions of whether sustainability cues influence consumer behavior toward deeper explanations of how and under what conditions such cues are cognitively processed and translated into purchase decisions (Feuß *et al.*, 2022; Lee *et al.*, 2020; Nikolaou and Kazantzidis, 2016).

E-commerce settings are inherently characterized by large volumes of information, time pressure, and limited opportunities for direct product inspection. Under such conditions, consumers often rely on simplified decision strategies, including heuristic processing and selective cognitive evaluation, to reduce uncertainty and make efficient decisions (Chaiken, 1980; Dhar and Gorlin, 2013; Honka *et al.*, 2024; Petty and Cacioppo, 1986). To explain these decision dynamics, this study integrates Signaling Theory, the Heuristic–Systematic Model (HSM), and Source Credibility Theory. Signaling Theory explains how eco-badges function as observable signals that reduce information asymmetry regarding sustainability attributes. The HSM explains how consumers cognitively process these signals when evaluating product information in information-dense environments. Meanwhile, Source Credibility Theory explains how the perceived credibility of sustainability labels influences whether consumers trust and utilize such information in their decision-making processes. Together, these theoretical perspectives provide a unified framework for understanding how sustainability-related visual cues operate as decision-relevant signals in digital marketplaces.

While prior studies have examined the relationships between sustainability cues, information usefulness, credibility, and purchase-related outcomes in isolation or within different empirical contexts (Delmas and Lessem, 2017; Taufique *et al.*, 2017; Testa *et al.*, 2021), this study does not replicate existing models. Instead, it integrates previously tested relationships into a unified mechanism–boundary framework that explains how sustainability cues are cognitively processed and translated into purchase decisions in information-dense e-commerce environments.

Eco-badges as sustainability signals and purchase decision

In online retail contexts marked by pronounced information asymmetry between sellers and consumers, sustainability attributes are commonly classified as credence attributes because their validity remains difficult to verify even after consumption. According to Signaling Theory, firms employ observable cues to convey otherwise unobservable product qualities and reduce information asymmetry (Connelly *et al.*, 2011; Spence, 1973). Eco-badges displayed on product pages serve precisely this function by signaling environmental friendliness and sustainability commitments under conditions of uncertainty.

Consistent with the Cue Utilization Framework, when intrinsic product attributes such as environmental impact are not directly accessible, consumers rely on extrinsic cues including labels, symbols, and visual icons to infer product quality (Jacoby *et al.*, 1971). Within information-dense e-commerce interfaces, eco-badges function as heuristic visual cues that simplify evaluative processes, draw attention to sustainability attributes, and facilitate quicker judgments. Empirical evidence from peer-reviewed international journals indicates that eco-labels and sustainability symbols positively influence product evaluations, perceived value, and related purchase outcomes in online contexts (Andreica Mihuş *et al.*, 2025; Grunert *et al.*, 2014; Kovač *et al.*, 2025).

In this study, purchase decision refers to consumers' final decision to buy a product through an e-commerce platform after evaluating available product information, including

sustainability-related cues including eco-badges (Elmor *et al.*, 2025; Majer *et al.*, 2022). Within digital retail environments, purchase decisions are often formed through rapid evaluations of multiple information cues presented on product interfaces. Therefore, eco-badges may directly influence purchase decisions by acting as salient sustainability signals shaping consumers' perceptions of product desirability and environmental value.

Taken together, these arguments suggest that eco-badges operate as salient sustainability signals that directly shape consumers' purchase decisions in e-commerce environments.

- H1. Eco-badges positively influence consumers' purchase decision on e-commerce platforms.

Perceived diagnosticity as a central cognitive mechanism

Although eco-badges may attract attention as heuristic signals, their influence on consumer decision-making does not depend solely on their visual presence, but critically on whether the information they convey is perceived as meaningful and decision-relevant. Perceived diagnosticity refers to the degree to which consumers perceive information as helpful, relevant, and useful for evaluating product alternatives and product quality, thereby facilitating purchase decisions and reducing uncertainty when comparing alternatives (Bian and Che, 2025; Huang *et al.*, 2024). In sustainability contexts, perceived diagnosticity reflects consumers' beliefs that eco-badge information genuinely assists them in assessing environmental attributes of products.

Drawing on the Information Processing Theory and HSM, consumers are more likely to incorporate information into their decision-making when it is perceived as highly diagnostic, particularly under conditions of cognitive constraint and information overload (Chaiken, 1980; Petty and Cacioppo, 1986). Diagnostic sustainability information enables consumers to move beyond superficial heuristic processing and integrate sustainability cues into more substantive evaluative judgments. Prior research demonstrates that perceived diagnosticity plays a critical role in information adoption and exerts a direct influence on product evaluations and purchase decisions in digital consumption environments, particularly where online interactive technologies and consumer processing of diagnostic information shape purchase intention (Liu and Yu, 2024; Uhm *et al.*, 2022; Wang *et al.*, 2024).

Importantly, in this study, perceived diagnosticity is conceptualized not as a peripheral informational attribute of eco-badges, but as the central cognitive mechanism transforming sustainability cues from attention-grabbing signals into actionable decision inputs. Accordingly, perceived diagnosticity explains how sustainability signals become decision-relevant, rather than functioning just as an additional predictor of purchase decision.

- H2. The perceived diagnosticity of eco-badge information positively influences consumers' purchase decision on e-commerce platforms.

Label credibility as a boundary condition

Despite the potential of eco-badges and diagnostic sustainability information influencing purchase decisions, their effectiveness is contingent upon consumers' perceptions of the credibility of the label source. Label credibility refers to the extent to which consumers perceive the sustainability label or eco-badge as trustworthy, reliable, and supported by legitimate certification or authoritative sources (Behre and Cauberghe, 2025; Delmas and Lessem, 2017). Source Credibility Theory posits that persuasive messages are more influential when their sources are perceived as trustworthy, reliable, and competent (Hovland and Weiss, 1951). In sustainability marketing contexts, label credibility is particularly critical, as environmental claims are frequently subject to consumer skepticism and concerns about greenwashing, especially in digital environments where direct verification is limited; repeated exposure to vague or unsubstantiated green claims can erode trust and weaken the persuasive

power of sustainability communication (Khan and Hinterhuber, 2025; Nyilasy *et al.*, 2014; Persakis *et al.*, 2025).

From a signaling perspective, signals only function effectively when they are perceived as credible by their recipients (Spence, 1973). Eco-badges originating from credible and legitimate sources are therefore more likely to be interpreted as valid sustainability signals, thereby enhancing their influence on purchase decisions (Atkinson and Rosenthal, 2014; Delmas and Lessem, 2017). Conversely, in the absence of sufficient label credibility, both heuristic sustainability signals and highly diagnostic information may fail to enter systematic evaluation, rendering their potential influence ineffective due to consumer skepticism. Empirical evidence from peer-reviewed journals indicates that label credibility amplifies the impact of sustainability cues on consumer responses, with credible eco-labels strengthening the relationship between sustainability signals and consumer purchase intentions as well as behavior in both online and green consumption contexts (Kim and Lee, 2023; Maftuchach *et al.*, 2025; Rossi and Rivetti, 2023).

Accordingly, label credibility is conceptualized in this study as a boundary condition that determines whether eco-badges and diagnostic sustainability information are cognitively utilized or dismissed during the online purchase decision process.

- H3. Label credibility strengthens the positive relationship between eco-badges and purchase decision, such that the relationship is stronger when label credibility is high.
- H4. Label credibility strengthens the positive relationship between perceived diagnosticity of eco-badge information and purchase decision, such that the relationship is stronger when label credibility is high.

Method

Research design

This study adopts a quantitative approach with an explanatory research design to examine the causal relationships among eco-badges, perceived diagnosticity, and purchase decision, as well as the moderating role of label credibility. An explanatory design is appropriate because the study is theory-driven and focuses on testing hypothesized relationships among latent constructs derived from Signaling Theory, the HSM, and Source Credibility Theory (Hair and Alamer, 2022; Hair *et al.*, 2019). Specifically, Signaling Theory explains how eco-badges function as observable signals that communicate otherwise unobservable sustainability attributes to consumers, the HSM explains how consumers cognitively process sustainability cues in information-dense online environments, and Source Credibility Theory explains how the perceived credibility of sustainability labels influences the acceptance and utilization of such information in purchase decision-making.

Population and sampling

The study population comprises millennial consumers aged 25–40 years who actively use e-commerce platforms in Indonesia. Millennials were selected because they generally exhibit higher levels of digital literacy and a greater tendency to rely on heuristic processing and visual cues when evaluating product information within information-dense online environments (Djamasbi *et al.*, 2010). This consumer segment is therefore particularly relevant for examining how visual sustainability signals such as eco-badges are interpreted and incorporated into online purchase decisions.

A purposive sampling technique was employed to target respondents with relevant experience in e-commerce and exposure to sustainability cues. The survey link was distributed to 243 potential participants through social media platforms and online shopping communities of active e-commerce users. The predefined eligibility criteria required respondents to be

millennial consumers aged 25–40 years who actively use e-commerce platforms in Indonesia, have made at least one online purchase within the past six months, and have prior exposure to eco-badges or sustainability labels displayed on e-commerce product pages. Respondents were instructed to evaluate eco-badges based on their experiences when browsing or purchasing products on e-commerce platforms where such sustainability labels were displayed.

To maintain conceptual equivalence, all measurement items were initially developed in English and translated into Indonesian using a back-translation procedure. An independent bilingual expert subsequently translated the Indonesian version back into English, and any discrepancies were discussed and resolved. Screening questions were included at the beginning of the questionnaire to confirm respondents' eligibility. In addition, a brief visual example of an eco-badge commonly displayed on e-commerce product pages was provided in the questionnaire to ensure that respondents clearly understood the sustainability cue being evaluated. After data screening, including the removal of incomplete responses and cases that failed the screening questions, 200 valid questionnaires were retained for further analysis, resulting in an effective response rate of approximately 82.3%. The relatively high response rate reflects the targeted purposive sampling and the distribution of the survey within online communities where members are actively engaged in e-commerce activities.

The minimum sample size was determined based on a prior statistical power analysis conducted using G*Power 3.1 (Cohen, 1988; Erdfelder *et al.*, 2009). Following the procedure recommended for multiple regression models in PLS-SEM, the calculation considered the maximum number of predictors pointing at a single endogenous construct in the structural model. Assuming a significance level of 5% ($\alpha = 0.05$), a minimum statistical power of 0.80, and a medium effect size ($f^2 = 0.15$), the G*Power analysis indicated the required minimum sample size ranged between 107 and 129 observations for a model with two main predictors and an interaction term representing the moderation effect. Therefore, the final sample of 200 valid responses substantially exceeded the minimum statistical requirement, indicating that the sample size was adequate to ensure sufficient statistical power and stable parameter estimation. This approach follows established methodological recommendations for determining minimum sample sizes in PLS-SEM research (Guenther *et al.*, 2023; Hair *et al.*, 2019).

Measurement of variables

All constructs in this study were conceptualized as reflective latent variables. Each construct was measured using indicators that were explicitly replicated and contextually adapted from previously validated scales. Specifically, the eco-badge construct was replicated and adapted from Panopoulos *et al.* (2023), the perceived diagnosticity construct was replicated and adapted from Jiang *et al.* (2021), the label credibility construct was replicated and adapted from Cai *et al.* (2017), and the purchase decision construct was replicated and adapted from Panopoulos *et al.* (2023).

The operationalization of these constructs is theoretically grounded in the conceptual framework developed from the literature review. Eco-badges represent observable sustainability signals communicated through visual markers on product pages, consistent with the Signaling Theory. Perceived diagnosticity captures consumers' cognitive evaluation of the usefulness and relevance of eco-badge information in product evaluation, reflecting the information processing mechanisms described in the HSM. Label credibility reflects consumers' trust in the legitimacy and reliability of sustainability claims conveyed through eco-badges, consistent with the Source Credibility Theory. Finally, purchase decision represents the behavioral outcome of consumers' evaluation process in e-commerce environments.

The measurement indicators were obtained from different authors and publication years and subsequently adapted to the e-commerce context. This contextual adaptation was

carried out without altering the original conceptual meaning of the indicators, thereby maintaining content validity while ensuring relevance to the research setting. All items were assessed using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Although Likert-type scales generate ordinal data, their use is widely accepted in behavioral and marketing research, particularly in studies employing structural equation modeling techniques. In the context of PLS-SEM, Likert-scale measurements are commonly treated as approximately continuous indicators because the method relies on variance-based estimation and does not require strict distributional assumptions. Previous studies published in leading journals have similarly applied PLS-SEM to analyze survey data measured with Likert scales, supporting the appropriateness of this approach for examining latent constructs in consumer behavior research (Hair *et al.*, 2019; Sarstedt *et al.*, 2022).

The constructs examined in this study therefore include eco-badges, perceived diagnosticity of eco-badge information, label credibility, and purchase decision. Although the measurement scales were replicated and contextually adapted from prior studies, this research is not classified as a replication study because it empirically tests a theoretically integrative model not examined in previous research.

To ensure transparency, conceptual clarity, and replicability, Table 1 presents the operational definitions and measurement indicators for each construct, including the original source studies from which the measurements were replicated and adapted.

Data collection procedure

Primary data were collected using a structured questionnaire administered via Google Forms. The instrument was designed and administered in Indonesian to ensure clarity and ease of understanding and consisted of four sections covering: respondent characteristics, perceptions of eco-badges, label credibility, and purchase decision. All items were presented as closed-ended statements based on established measurement indicators.

To minimize the risk of common method bias, respondents were assured of anonymity and informed the survey was conducted solely for academic purposes. The data collection process was conducted over a one-month period from November to December 2025 using a cross-sectional approach, capturing respondents' perceptions and evaluations at a single point in time (Keith *et al.*, 2023; Wright, 2005).

Data analysis technique

The data were analyzed using consistent PLS-SEM with the assistance of ADANCO software. PLS-SEM was chosen because the objective of this study was to examine theoretically derived relationships among multiple latent constructs and to estimate a predictive structural model involving moderation effects in an exploratory e-commerce context. Compared to covariance-based SEM (CB-SEM), the PLS-SEM is particularly suitable when the research objective focuses on prediction and theory development rather than strict model confirmation (Dijkstra and Henseler, 2015; Henseler *et al.*, 2016; Schuberth *et al.*, 2023).

Furthermore, PLS-SEM is appropriate for models that incorporate multiple constructs, complex relationships, and interaction effects while maintaining robustness under conditions of non-normal data distributions and moderate sample sizes, which are commonly encountered in behavioral research using survey data. In this study, the structural model includes direct relationships between eco-badges, perceived diagnosticity, and purchase decision, as well as the moderating effect of label credibility, making PLS-SEM an appropriate analytical technique. To evaluate the statistical significance of the structural paths, a non-parametric bootstrapping procedure with 10,000 resamples was applied, following established methodological recommendations for PLS-SEM analysis (Sarstedt *et al.*, 2022).

Table 1. Operational definitions and measurement indicators of the study constructs

Variable	Code	Measurement indicator	Key reference
Eco-Badge (X1)	EB1	The eco-badge clearly signals that the product has environmentally friendly attributes	Panopoulos et al. (2023)
	EB2	The eco-badge makes sustainable attributes easy to recognize on the product page	
	EB3	The eco-badge simplifies my ability to identify sustainable products online	
	EB4	The presence of an eco-badge increases my attention to the product's sustainability attributes	
	EB5	The eco-badge improves my understanding of the product's environmental benefits	
Perceived Diagnosticity (X2)	PDG1	The eco-badge provides information that is useful for evaluating sustainability attributes of the product	Jiang et al. (2021)
	PDG2	The eco-badge helps me better understand key product sustainability traits	
	PDG3	The eco-badge improves my ability to compare sustainability characteristics between products	
	PDG4	The information from the eco-badge decreases ambiguity when choosing environmentally friendly products	
	PDG5	The eco-badge provides enough information to assist my purchase decision	
Label Credibility (M)	LC1	I believe the eco-badge comes from a trustworthy and reliable source	Cai et al. (2017)
	LC2	I trust the sustainability information conveyed by the eco-badge	
	LC3	The eco-badge reflects legitimate environmental claims	
	LC4	I consider the eco-badge credible compared to other sustainability claims online	
	LC5	I rarely doubt whether the eco-badge reflects true environmental performance	
Purchase Decision (Y)	PD1	I intend to purchase products that display an eco-badge	Panopoulos et al. (2023)
	PD2	I am more likely to choose products with eco-badges than similar products without them	
	PD3	The eco-badge information influences my final purchase decision	
	PD4	I feel confident deciding to buy products that have eco-badges	
	PD5	Overall, seeing eco-badges increases my likelihood of purchasing sustainability-oriented products	

Findings and discussion

The study involved 200 millennial consumers aged 25–40 years in Indonesia selected through purposive sampling to ensure relevant e-commerce experience and exposure to sustainability cues. All respondents included in the final dataset met the predefined eligibility criteria, including the age range of 25–40 years, which corresponds to the millennial consumer segment targeted in this study. The sample consisted of 52% female and 48% male respondents aged 25–40 years, with 39% aged 30–34 years. Most respondents held at least a bachelor's degree (59%), were employed in the private or public sector (61%), and reported monthly incomes predominantly between IDR 5–10 million (43%) or above IDR 10 million (30%). In terms of online shopping behavior, 86% of respondents engaged in e-commerce transactions at least weekly, indicating substantial familiarity with digital retail interfaces and sustainability-related information. This sampling approach is appropriate for theory testing, as it captures a digitally literate consumer segment most likely to cognitively process and respond to eco-badges and related sustainability signals.

Measurement model assessment

Referring to [Table 2](#), indicator reliability was evaluated using outer loadings with a recommended cut-off value of 0.70 ([Sarstedt et al., 2022](#)). Most indicators exceed this threshold, denoting satisfactory indicator reliability. Several indicators exhibit loadings between 0.50 and 0.70; however, such values are acceptable in confirmatory PLS-SEM when supported by adequate construct-level reliability and convergent validity ([Sarstedt et al., 2022](#)). Although a small number of indicators fall within this range, removing these indicators did not improve the composite reliability or average variance extracted (AVE) values of the corresponding constructs; as a result, they were retained in the measurement model. This condition is met, as all constructs demonstrate composite reliability values above 0.70 ([Nunnally and Bernstein, 1994](#); [Sarstedt et al., 2022](#)) and Cronbach's alpha coefficients exceeding 0.70, confirming internal consistency reliability.

Convergent validity was assessed using the AVE. As shown in [Table 2](#), all AVE values are above the recommended cut-off of 0.50 ([Fornell and Larcker, 1981](#); [Sarstedt et al., 2022](#)), indicating that each construct explains more than half of the variance of its indicators. Overall, the measurement model meets the recommended criteria for indicator reliability, internal consistency, and convergent validity.

As reported in [Table 3](#), discriminant validity was assessed using the heterotrait–monotrait ratio (HTMT). All HTMT values are below the conservative threshold of 0.85, indicating that

Table 2. Measurement model assessment

Construct	Indicator	Loading	Cronbach's Alpha	Composite Reliability (CR)	AVE
EB	EB1	0.853	0.901	0.904	0.658
	EB2	0.850			
	EB3	0.547			
	EB4	0.859			
	EB5	0.896			
PDG	PDG1	0.864	0.918	0.918	0.693
	PDG2	0.924			
	PDG3	0.868			
	PDG4	0.765			
	PDG5	0.726			
LC	LC1	0.832	0.878	0.877	0.592
	LC2	0.624			
	LC3	0.772			
	LC4	0.689			
	LC5	0.900			
PD	PD1	0.576	0.873	0.861	0.567
	PD2	0.607			
	PD3	0.614			
	PD4	0.924			
	PD5	0.949			

Table 3. Discriminant validity and collinearity diagnostics

Constructs	EB	PDG	LC	PD	Max VIF
Eco-badges (EB)	–				3.532
Perceived diagnosticity (PDG)	0.368	–			3.041
Label credibility (LC)	0.061	0.329	–		2.418
Purchase decision (PD)	0.578	0.655	0.500	–	3.118

discriminant validity is well established (Henseler *et al.*, 2015; Sarstedt *et al.*, 2022). This result confirms that the constructs are empirically distinct.

Collinearity was examined using variance inflation factor (VIF) values. The maximum VIF value is 3.532, which is below the recommended cut-off value of 5.0 in PLS-SEM (Sarstedt *et al.*, 2022). Therefore, multicollinearity is not a concern in the structural model.

Structural model results and model fit

Based on Table 4, the structural model results indicate that all proposed hypotheses are empirically supported. All direct and moderating paths exhibit t-values exceeding the recommended cut-off value of 1.96, indicating statistical significance at the 5% level. The direct effects of eco-badges ($\beta = 0.342$; $p < 0.001$) and perceived diagnosticity ($\beta = 0.472$; $p < 0.001$) on purchase decision are positive and significant, with perceived diagnosticity showing the strongest influence, suggesting that consumers rely more on informative sustainability cues than on visual signals alone.

The moderating role of label credibility is also confirmed. The interaction between label credibility and eco-badges ($\beta = 0.127$; $p = 0.012$; $f^2 = 0.061$) and between label credibility and perceived diagnosticity ($\beta = 0.175$; $p = 0.011$; $f^2 = 0.083$) is statistically significant. Although the effect sizes of the interaction terms are relatively small, such magnitudes are theoretically expected because moderators typically operate as boundary conditions that influence the strength of the relationships between independent and dependent variables, rather than acting as primary predictors of the outcome (Aguinis, 2004; Baron and Kenny, 1986; Edwards and Lambert, 2007). These findings therefore support the argument that label credibility qualifies and conditions the impact of eco-badges and perceived diagnosticity on purchase decisions.

Because moderation was estimated using latent variable interaction terms within the consistent PLS-SEM framework, its interpretation is based on the statistical significance and effect sizes of the interaction terms as well as changes in explanatory power (ΔR^2). In variance-based SEM, when latent interaction terms are modeled directly, moderation can be appropriately assessed through the significance and effect size of the latent interactions and the change in explained variance, while graphical simple-slope probing is optional rather than mandatory (Aguirre-Urreta *et al.*, 2019; Hair and Alamer, 2022; Henseler *et al.*, 2016). Consistent with this assessment, the R^2 value for purchase decision increases from 0.713 to 0.749 after incorporating the interaction terms, indicating improved explanatory power, while the SRMR value of 0.076 remains below the recommended threshold of 0.08, indicating acceptable model fit (Sarstedt *et al.*, 2022).

Collectively, these results underscore the integrative role of eco-badges, perceived diagnosticity, and label credibility in shaping Purchase Decision, an interrelationship that is visually articulated in the structural model presented in Figure 1.

The moderating effects were modeled using interaction constructs between label credibility and the predictor variables. Specifically, the moderation terms $LC \times EB$ and $LC \times PDG$

Table 4. Structural model results, explanatory power, and model fit

Path	β	t-value	p-value	f^2	R^2 (before)	R^2 (after)	Decision
EB $\rightarrow$ PD	0.342	4.911	<0.001	0.365			Supported
PDG $\rightarrow$ PD	0.472	6.482	<0.001	0.601			Supported
LC $\times$ EB $\rightarrow$ PD	0.127	2.523	0.012	0.061			Supported
LC $\times$ PDG $\rightarrow$ PD	0.175	2.562	0.011	0.083			Supported
Explanatory power (R^2)					0.713	0.749	
Model fit (SRMR)							0.076

represent interaction effects created between the latent constructs of label credibility with eco-badges and perceived diagnosticity, respectively. In PLS-SEM, these moderation constructs do not contain independent measurement indicators because they are generated as interaction terms derived from the indicators of the interacting latent variables. Therefore, the blank cells shown in Figure 1 indicate the moderation constructs were estimated using the product indicator approach implemented in ADANCO, rather than being measured as independent latent constructs.

Discussion and implications
Discussion of findings

From a digital retailing perspective, the findings of this study demonstrate that sustainability cues embedded within e-commerce interfaces influence consumer purchase decisions only when such cues provide cognitively diagnostic information and originate from sources perceived as credible. These results provide a deeper understanding of how sustainability-related signals are interpreted and utilized by consumers in information-dense e-commerce environments. Rather than functioning as isolated predictors, eco-badges, perceived diagnosticity, and label credibility collectively explain how sustainability cues are cognitively processed and translated into purchase decisions. This integrative explanation suggests that sustainability communication in digital retail settings operates through the interaction of heuristic signals, cognitive evaluations, and trust-based judgments. Accordingly, sustainability cues should not be viewed as static informational attributes but as conditional signals whose effectiveness depends on consumers' cognitive interpretation of the information conveyed and their evaluation of the credibility of the signal source.

The results indicate that eco-badges positively influence purchase decisions, supporting the proposed relationship that visual sustainability symbols embedded in e-commerce product interfaces can guide consumer behavior. This finding suggests that eco-badges function as heuristic visual cues simplifying complex product evaluations by directing consumer attention toward sustainability-related attributes. From the perspective of signaling theory, eco-badges serve as observable signals helping to reduce information asymmetry between sellers and

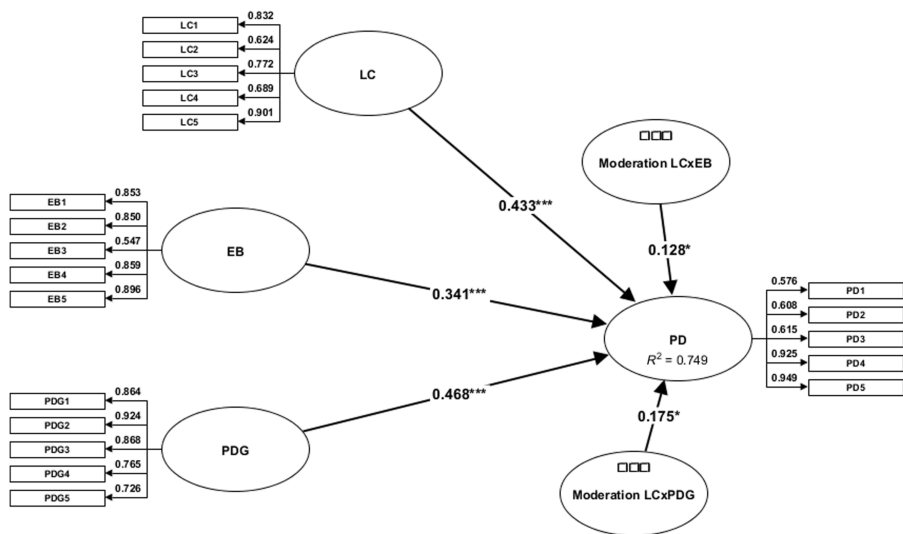


Figure 1. Structural model estimation results using ADANCO

consumers by communicating otherwise unobservable environmental product attributes (Connelly *et al.*, 2011; Spence, 1973). Because sustainability attributes are typically classified as credence attributes consumers cannot easily verify, even after product consumption, external signals such as eco-badges become important mechanisms through which firms communicate environmental quality. In digital shopping environments characterized by information overload and limited attention, such visual signals play an important role enabling consumers to quickly identify products that potentially align with their environmental preferences (Andreica Mihut *et al.*, 2025; Majer *et al.*, 2022).

However, the magnitude of this effect suggests that eco-badges alone may not be sufficient to strongly drive purchasing behavior. Compared with the cognitive influence of perceived diagnosticity, the direct effect of eco-badges appears relatively modest, indicating that visual sustainability cues primarily function as attention-directing signals rather than fully persuasive informational elements. This observation aligns with the HSM of information processing, which suggests that consumers often rely on heuristic cues when facing cognitive constraints or information overload (Chaiken, 1980; Petty and Cacioppo, 1986). Within such environments, heuristic cues facilitate quick judgments but do not necessarily produce strong behavioral responses unless consumers also perceive the underlying information as meaningful and trustworthy. Consistent with prior sustainability communication research, eco-labels and environmental symbols may lose persuasive power when consumers become skeptical of environmental claims or perceive such labels as superficial marketing instruments rather than credible indicators of environmental performance (Gorton *et al.*, 2021; Persakis *et al.*, 2025; Rossi and Rivetti, 2023).

Beyond the presence of visual sustainability cues, the findings further reveal that consumers' purchase decisions are strongly influenced by the perceived diagnosticity of the information conveyed by eco-badges. Information consumers perceive as useful, relevant, and capable of reducing uncertainty exerts a stronger influence on purchase decisions than symbolic cues alone. This result highlights the importance of cognitively meaningful sustainability information in digital consumption environments. Perceived diagnosticity reflects the degree to which consumers believe available information assists them in evaluating product attributes and comparing alternatives. In e-commerce contexts where direct product inspection is not possible, diagnostically useful information becomes particularly important because it helps compensate for the absence of physical product experience.

This finding is consistent with information processing theory and the heuristic-systematic processing framework, which suggest that consumers selectively process information based on its perceived usefulness for decision-making (Chaiken, 1980; Petty and Cacioppo, 1986). When information is perceived as highly diagnostic, consumers are more likely to incorporate that information into their evaluative judgments and purchasing decisions. Conversely, when information is perceived as less useful or less relevant, consumers tend to rely on superficial cues or heuristic shortcuts. By empirically demonstrating the strong influence of perceived diagnosticity on purchase decisions, this study reinforces prior research emphasizing the critical role of diagnostic information in shaping consumer judgments and choice processes in online environments (Jiang *et al.*, 2021; Liu and Yu, 2024; Uhm *et al.*, 2022). In this sense, eco-badges influence purchase decisions not merely because they signal sustainability attributes, but because the information they convey is interpreted by consumers as meaningful and useful for evaluating environmental product characteristics.

The analysis also shows that the effectiveness of sustainability cues depends strongly on the perceived credibility of the label source. Label credibility not only exerts a direct influence on purchase decisions but also strengthens the influence of eco-badges on purchasing behavior. This finding suggests eco-badges originating from credible and trustworthy sources are more likely to be interpreted as valid sustainability signals. In contrast, when the credibility of the label source is low, consumers may discount eco-badges as potential greenwashing or marketing exaggeration. These results are consistent with source credibility theory, which

posits messages originating from credible sources are more persuasive and more likely to influence behavioral outcomes (Hovland and Weiss, 1951). In digital environments where consumers cannot directly verify environmental claims, credibility becomes a critical factor in determining whether sustainability signals are accepted or rejected.

Furthermore, the results indicate that label credibility strengthens the influence of perceived diagnosticity on purchase decisions. Even when sustainability information is perceived as highly useful for evaluating product alternatives, its persuasive impact depends on consumers' trust in the source providing that information. When the credibility of the label source is high, diagnostically useful sustainability information is more likely to be accepted as reliable and incorporated into the decision-making process. Conversely, when credibility is low, even highly informative sustainability cues may fail to influence purchasing behavior because consumers question the reliability of the information. This interaction suggests cognitive evaluations of informational usefulness and trust-based evaluations of credibility operate jointly rather than independently. Diagnostic information enhances the perceived usefulness of sustainability cues, while credibility determines whether the information is trusted. By demonstrating label credibility conditions the effect of perceived diagnosticity, this study extends prior research on eco-label effectiveness and sustainability communication by providing a more nuanced explanation of how trust governs the cognitive processing of sustainability cues in online retail environments (Gorton *et al.*, 2021; Persakis *et al.*, 2025; Rossi and Rivetti, 2023).

More importantly, the moderating role of label credibility offers further theoretical insight by showing that credibility acts as a boundary condition determining when sustainability cues translate into actual purchase behavior. This implies that eco-badges are not inherently persuasive but rather their influence depends on the degree to which consumers trust the source of the sustainability claim. From this perspective, the findings extend signaling theory by highlighting that the effectiveness of signals is shaped not only by their presence, but also by how reliable the signaling source is perceived to be (Connelly *et al.*, 2011; Spence, 1973).

In addition, this moderating effect underscores the interplay between cognitive evaluation and trust in consumer decision-making. While perceived diagnosticity captures how useful sustainability information is for evaluating products, label credibility determines whether that information is accepted as trustworthy and actionable. In this regard, credibility functions as a validating mechanism that enables diagnostically useful information to meaningfully influence purchase decisions (Hovland and Weiss, 1951). Without sufficient credibility, even highly informative sustainability cues may fail to produce behavioral responses.

Furthermore, this interaction provides a more refined interpretation of the HSM by illustrating heuristic cues related to source credibility and systematic evaluations of information diagnosticity work together rather than independently in shaping consumer judgments (Chaiken, 1980; Petty and Cacioppo, 1986). Therefore, the effectiveness of sustainability communication in e-commerce depends on the alignment between the quality of information and the credibility of its source, rather than on either factor in isolation.

Theoretical implications

Taken together, these findings suggest that sustainability communication in e-commerce is most effective when heuristic visual cues, cognitively diagnostic information, and credible sources operate in tandem. Eco-badges may attract consumers' initial attention, but their influence on purchase decisions ultimately depends on the extent to which the information conveyed is perceived to be meaningful and trustworthy. This finding indicates eco-badges function as informational signals to reduce consumer uncertainty in online environments, consistent with signaling theory. More specifically, this study demonstrates the effectiveness of such signals is not inherent in their visual presence alone, but is contingent upon their ability to convey decision-relevant information consumers perceive as useful in evaluating product attributes under information asymmetry conditions. By integrating signaling theory, heuristic–

systematic processing perspectives, and source credibility theory, this study advances the sustainability marketing literature by clarifying the mechanisms and boundary conditions through which visual sustainability cues are transformed into behavioral outcomes in digital marketplaces characterized by information overload and heightened consumer skepticism (Andreica Mihuț *et al.*, 2025; Majer *et al.*, 2022; Persakis *et al.*, 2025).

The contribution of this study lies not in introducing new constructs, but in deepening understanding of the cognitive pathways through which sustainability cues become decision-relevant in contemporary e-commerce environments. Specifically, the central role of perceived diagnosticity highlights how consumers rely on eco-badges as cognitively useful cues in line with the HSM, suggesting that diagnosticity serves as the key mechanism through which heuristic cues are translated into meaningful evaluations that directly inform purchase decisions.

The moderating role of label credibility further demonstrates that the effectiveness of such cues depends on the perceived trustworthiness of the information source. This finding is consistent with source credibility theory, which emphasizes information is more likely to be accepted and utilized when it originates from credible and reliable sources. By positioning perceived diagnosticity as the central cognitive mechanism and label credibility as a boundary condition, this study contributes to sustainability marketing and digital consumption literature by clarifying the cognitive pathways through which sustainability signals shape online purchase behavior. In this regard, the study provides a more nuanced explanation of how consumers process sustainability information in digital environments, highlighting that decision-making is driven not merely by the presence of sustainability cues, but by the extent to which such cues are cognitively processed as informative and reliable signals. This framework deliberately focuses on sustainability cue processing at the point of online purchase decision-making and does not seek to explain post-purchase evaluations or long-term attitude change.

Managerial implications

The findings highlight that simply displaying eco-badges is not enough to drive sustainable purchasing, therefore marketers and e-commerce platforms must adopt a more strategic approach to sustainability communication. First, visual eco-badges should be supplemented with concise, clearly presented diagnostic information that explains product sustainability attributes in a meaningful and verifiable manner. This may include transparent criteria, lifecycle impacts, or third-party certifications.

Second, credibility should be treated as a central priority. Platforms can strengthen trust by collaborating with recognized certification bodies, as prior studies indicate that third-party certification plays a crucial role in shaping consumer trust and purchase intention toward sustainable products (Cai *et al.*, 2017; Yang *et al.*, 2024). Furthermore, platforms can implement standardized verification procedures and avoid the use of ambiguous self-declared labels that may be perceived as greenwashing. Trust can be further reinforced by integrating interactive features such as verification links, QR codes, or traceability tools enabling consumers to independently validate sustainability claims.

Finally, given limited consumer attention in online environments, strategic placement and consistent formatting of eco-labels can improve visibility and recognition without overwhelming consumers. Collectively, these actions can strengthen the persuasive power of sustainability cues and support more confident and informed green purchase decisions.

Conclusion

This study was motivated by the growing use of eco-badges in e-commerce platforms and the limited understanding of how such sustainability cues influence consumer purchase decisions in digital retail environments. Addressing this gap, the study examined the roles of perceived diagnosticity and label credibility in explaining how eco-badges affect purchase decisions.

The findings show eco-badges, perceived diagnosticity, and label credibility significantly influence purchase decisions, with perceived diagnosticity emerging as the strongest predictor. In addition, label credibility strengthens the effects of eco-badges and perceived diagnosticity, indicating sustainability cues are more influential when the information provided is perceived as both useful and trustworthy.

This study contributes to the literature by explaining the cognitive mechanism and boundary conditions through which eco-badges influence online purchase decisions. The findings suggest that e-commerce platforms should complement eco-badges with clear sustainability information and credible certification sources to enhance consumer trust and support informed green purchasing behavior.

Future research directions

Despite its contributions, this study is subject to several limitations that open opportunities for future research. First, the empirical data were collected from millennial consumers in Indonesia, which may limit the generalizability of the findings to other demographic groups or cultural contexts where sustainability perceptions and trust in eco-labels may differ. In addition, the study employs a cross-sectional survey design based on self-reported responses, which captures consumer perceptions at a single point in time and may not fully reflect how repeated exposure to sustainability cues influences purchasing behavior over time. The research also focuses specifically on eco-badges as visual sustainability signals embedded within e-commerce interfaces, while other forms of sustainability communication were not incorporated into the model.

Future research could therefore extend these findings in several ways. Studies may examine eco-badge effectiveness across different product categories, as sustainability cues may be more influential in credence-based goods compared to utilitarian or hedonic products. Further research could also explore the role of individual differences—such as environmental involvement, skepticism, or digital literacy—in moderating responses to sustainability signals. Longitudinal or real-world field experiments may provide deeper insight into how repeated exposure to credible sustainability cues shapes trust and purchase behavior over time. Moreover, emerging technologies such as AI-generated sustainability summaries, blockchain-based traceability systems, or augmented reality labels could be investigated to determine whether they enhance perceived diagnosticity and credibility. Finally, comparative studies across cultural or regional markets may reveal contextual factors that influence how consumers interpret and respond to eco-labels, thereby offering a more global understanding of sustainable e-commerce communication.

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