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Does Eco-Literacy Matter? The Impact of Green Marketing Communication Practices on Green Purchasing Behavior

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Abstract

Sustainable marketing has recently gained attention due to its role in achieving the Sustainable Development Goals (SDGs), particularly SDG-12: Responsible Consumption and Production. Despite growing research interest in this topic, consumer perceptions of green products remain inconsistent and skeptical. Underpinned by Signaling Theory, this study aims to examine the influence of green marketing communication practices (eco-labels, green advertising, social media marketing, and green user-generated content) on green product purchasing behavior. Besides, this study also aims to investigate the moderating role of eco-literacy in the relationship between green marketing communication practices and green purchasing behavior. Following a quantitative design, survey data were collected from 183 green product consumers through a purposive sampling technique and analyzed using Partial Least Squares Structural Equation Modeling. The results show that green advertising and green user-generated content are the green marketing communication practices that positively influence green purchasing behavior, while the practices of eco-labels and social media marketing do not affect green purchases. Additionally, the findings indicate that eco-literacy does not moderate the relationship between green marketing communication practices and purchasing behavior. We contribute unique insights to the green marketing discourse and Signaling Theory by integrating green marketing communication practices and eco-literacy within a single framework, particularly in the context of emerging markets. Apart from enriching green marketing scholarship, this study carries implications for green product retailers to embrace specific green marketing communication

strategies that attract young consumers. The findings also inform educational institutions and consumer agencies on the importance of cultivating eco-literacy and consumer awareness to support the SDGs.

Keywords: eco-label, green advertising, green user-generated content, social media marketing, eco-literacy, purchase behavior, green consumption

1.0 Introduction

As climate change is becoming a severe global issue, growing environmental and sustainability concerns have rapidly taken hold of global discourse (Babar et al., 2024; Nabawanda, 2023; World Health Organization, 2022). Malaysia is no exception; the Southeast Asian country is vulnerable to the warmer climates caused by rising global temperatures, known as the El-Nino phenomenon. Since the country heavily relies on agriculture and plantation corporations to support its economy, the increasing frequency of the El-Nino phenomenon can severely harm Malaysia's crop production and threaten its agricultural sector (Owusu et al., 2019). For instance, rising temperatures can reduce soil fertility, spread pests and diseases, and lower crop quality. In addition, unpredictable climate conditions can significantly affect the nation's gross domestic product (GDP), economic growth, and production systems (Wan Mohd Noor et al., 2024). Therefore, pro-environmental initiatives are imperative, not only at the government level but also among corporations. Growing consumer interest in environmentally friendly products and services (Armutcu et al., 2023; Bravo et al., 2022) makes it necessary for businesses to participate in the green economy. By doing so, they can promote goods and services that contribute meaningfully to carbon neutrality and sustainable development, while also maintaining economic growth (MIDA, 2024).

In addition to actively engaging in the green economy, effective green marketing communication initiatives are crucial, as before the company can succeed in sustainable initiatives, it needs to project green messages to influence the public on pro-environmental behaviors and contribute to a healthier planet. As such, many corporations have adopted green marketing communication practices to influence consumers' purchases of their green products (Stoica, 2021).

According to Wu and Long (2024), green marketing communication involves the transmission and exchange of green-related information, involving practices like green advertising, eco-

labels, social media marketing, and green user-generated content (UGC) (Chan et al., 2025; Nabivi, 2025; Wu & Long, 2024). Eco-labels were defined as a certification system that identifies products that are less harmful to the planet (Liu et al., 2023). Eco-label encourages businesses to support the circular economy while providing customers with credible and reliable product information. Green advertising refers to persuasive green messages to influence consumers to practice sustainable consumption (Schmuck et al., 2018), as it is important that green advertising serves as the signal/message to influence green behavior. Social media marketing is defined as the utilization of social media platforms to reveal a company and its green products' information (Sharma & Vemal, 2018). Green UGC is described as the information exchange of green products by consumers on various media content platforms (Zhao et al., 2023). Thus, social media marketing and green UGC are crucial as they can leverage the influence of online communities to promote green purchase behavior across various sectors, such as hospitality and beauty (Mohamed Sadom et al., 2022; Yildiz et al., 2023).

Green purchase behavior is defined as the purchase of products/services that are environmentally friendly (Hlaváček et al., 2023), and significantly, it can lessen the manufacturing, consumption, and recycling impacts on the environment. Besides, eco-literacy refers to the understanding of ecological principles and the knowledge necessary to make informed and sustainable decisions that benefit the planet (Pouresmaieli et al., 2024), as it helps people to be aware and provide knowledge on the connection between the environment and human activities.

As a relatively new concept, however, green marketing communication is still in its early stages of research and development (Stoica, 2021), leaving several gaps to be addressed. Although there is a plethora of research that explores green purchasing behavior through the lens of the Theory of Planned Behavior (attitude, subjective norms, perceived behavioral control) (Brandão & Costa, 2021; Rahman et al., 2020; Ramany et al., 2022). However, studies that utilized the Signaling Theory, particularly looking from the angle of how the green messages are being communicated, need further investigation (Jia et al., 2023; Liao et al., 2020) to address the theoretical gap.

Whilst traditional marketing strategies have been evaluated concerning green purchasing behavior (Majeed et al., 2022; Sripathi et al., 2022), the growing prominence of social media marketing and user-

generated content (UGC) has yet to be studied in detail (Armutcu et al., 2023; Gouda & Halim, 2025; Nabivi, 2025). This is because traditional marketing, such as print, broadcast, and direct mail, focuses on offline marketing strategies and lacks interactivity (Zlatanov & Đuričanin, 2023). Therefore, this study addressed the gap as social media marketing and UGC have evolved into popular mediums for businesses to promote their green products due to the growing prominence of online buying. For instance, El-Shihy and Awaad (2025) mentioned that platforms such as TikTok and Instagram are prominent media for the younger generations to leverage for sustainable fashion. Uniquely, these channels offer bidirectionality and interoperability, enhancing persuasive power over consumers (Zha et al., 2023) and in line with Signaling Theory.

Past studies have examined the UGC's impact on green behavior (Panopoulos et al., 2023; El-Shihy & Awaad, 2025). However, the green UGC that is created by the consumer as marketing communication signals to promote sustainability and ecological awareness requires further exploration based on the perspective of Signaling Theory (Twum & Yalley, 2021), particularly Signaling Theory highlighted that green UGC that created by consumers are more reliable and thus reduce the information asymmetry as the messages are more authentic and less biased compared to those information from the company (Ikhsan et al., 2024). Although there is a study that explored the sustainability and UGC (El-Shihy & Awaad, 2025), this study sheds light by integrating the green UGC as the green marketing communication practices, which is novel, and this has been supported by numerous scholars (e.g., Chen et al., 2023; Patil et al., 2024; Seyfi et al., 2025) that research on green marketing communication is timely. Thus, this study addressed the gap by including social media marketing and green UGC to expand the green marketing communication attributes.

Besides, previous studies have tested eco-literacy as an independent variable (Liu & Tobias, 2024; Salem et al., 2025; Tiwari, 2023) or served as a moderator (Bhutto & Rūtelionė, 2024; Rai et al., 2025). However, the examination of eco-literacy as a moderator of green marketing communication and purchasing behavior is scarce. Hence, this study aims to address the conceptual gap of eco-literacy. Additionally, the findings from previous research are inconsistent. For instance, Elistia et al. (2023) found that eco-literacy moderated the path between subjective norms and purchase intentions of sustainable

energy home appliances, which aligned with the study of Rai et al. (2025), which found that eco-literacy was able to moderate the relationship between the three attributes of the theory of planned behavior and energy-efficient appliances. This also aligned with Law et al. (2023) that environmental literacy is able to moderate between personal agency, attitude, perceived norms, and recycling intention. However, Bhutto and Rūtelionė (2024) found differently, where eco-literacy is not a moderator of the usage, value, and image barriers on purchase intention, which urged the researchers to re-examine the study due to the inconsistency in the findings. Despite showing some improvement, the level of eco-literacy remains relatively low in Malaysia, warranting further research in the emerging context (Norkhaidi et al., 2021). Thus, this study tests the eco-literacy as the moderator on the paths of green marketing communication practices and green purchase behaviour, which is unique and yet to be tested.

Ultimately, as Malaysia is striving towards sustainable change, it is vital to comprehend how corporations' green marketing communication practices and consumers' eco-literacy interact to influence green purchasing behavior in the local context. Therefore, this study aims to address the aforementioned research gaps by investigating the effects of four green marketing communication practices (eco-labels, green advertising, social media marketing, and green UGC) on green purchasing behavior via the moderating role of eco-literacy.

2.0 Literature Review

2.1 Theoretical Foundation

Signaling Theory, first introduced by Michael Spence in 1973 (Spence, 1973) and later conceptualized by Connelly et al. (2011), is a model consisting of three components: the signaler (firm/seller), the receiver (consumer), and the signal (message). In marketing and advertising, signals are used to bridge information barriers between sellers and consumers. Firms employ signals to communicate the true qualities of their products, including price, brand name, licensing, and advertising channels (Connelly et al., 2011). In this study, Signaling Theory provides a framework through which firms effectively convey their green marketing communication practices (eco-labels, green advertising, social media marketing, and green UGC) to consumers, who then interpret these signals and are stimulated to purchase green

products (Correia et al., 2023; Nabivi, 2025; Twum & Yalley, 2021). Therefore, Signaling Theory supports the use of green marketing communication to disseminate favorable green information that motivates consumers' green product purchases (Chan et al., 2025; Liao et al., 2020), benefiting both organizations and consumers.

2.2 Hypothesis Development

Eco-labels play a vital role by emphasizing the environmentally friendly attributes of the product and further stimulating green purchasing behavior (Kumar & Basu, 2023; Panopoulos et al., 2023). Moreover, eco-labels can increase the credibility and trustworthiness of a product. Hence, based on scholars (Riskos et al., 2021; Sigurdsson et al., 2022), who have applied the Signaling theory, induced consumers to recognize eco-labels as reliable sources of information (signals), where the effectiveness of the eco-labels (messages) influences consumers' purchasing decisions on green products as the outcome (Haribhakti & Pandya, 2023; Proi et al., 2023; Tan et al., 2019). According to these studies, researchers proposed the hypothesis:

H1: Eco-labels positively impact green purchasing behavior.

Green advertising is capable of spreading environmental awareness and highlighting the significance of sustainable consumption. This aligned with the Signaling theory that green advertising as a form of green messaging allowed consumers to be further convinced and persuaded to purchase green products (Chan et al., 2025; Tan et al., 2019). On the authority of Shi and Jiang (2023), functional and emotional green advertising have a positive influence on green purchasing behavior, with emotional green advertising having greater receptivity towards green consumers. Additionally, the use of repetitive green advertising across multiple media channels has the potential to increase green message credibility and customer trust (Correia et al., 2023; Khandelwal & Singh, 2023; Martins, 2022). Following these results, the researchers proposed the hypothesis:

H2: Green advertising positively impacts green purchasing behavior.

Ramany et al. (2022) highlighted that digital/social media interactions allow consumers to authentically participate in green

purchasing behavior. Unique to other media platforms, social media marketing provides a two-way communication channel between buyers and sellers. Consumers can inquire about the product or service in real time and receive a response swiftly. These interactions have a positive influence on green purchasing behavior (Chan & Ramlan, 2024; Sharma & Verma, 2018). Social media marketing empowers online users to share their personal experiences regarding the product. This aligned with the Signaling Theory that social media marketing content serves as a credible source of information (Shamim & Azam, 2024) and further persuades consumers to enact green purchasing behavior (Armutcu et al., 2023). Therefore, the researchers postulated the hypothesis:

H3: Social media marketing has a positive impact on green purchasing behavior.

User-generated content (UGC) has become one of the effective tools in consumer purchase behavior (Geng & Chen, 2021). UGC is described as developed media content that is primarily for the general public through social media. In other words, UGC is created by public viewers rather than profitable organizations or paid professionals using multiple mediums and channels (Santos, 2022). To differentiate from traditional communication channels, users in online communities find UGC to be more effective in facilitating interaction quality that enhances the consumer's purchase intention (Geng & Chen, 2021; Panopoulos et al., 2023). Therefore, it is often considered a trustworthy and credible source of information as it is not sponsored by independent opinion leaders (Cheung et al., 2021). This supported the notion of the Signaling Theory that consumers' reviews are more genuine and will reduce the information asymmetry (Yu et al., 2024), which supported the study of Zhao et al. (2023) that UGC that served as green social media communication positively affects the consumers' intention to co-create green value. Thus, the following hypothesis is formulated:

H4: There is a positive impact of green UGC and green purchasing behavior.

Eco-literacy refers to the understanding of ecological principles and the knowledge necessary to make informed and sustainable decisions that benefit the environment (Pouresmaieli et al., 2024). Thus, consumers with high eco-literacy will make sustainable choices,

including buying green products (organic food) (Carrión Bósquez et al., 2023). For instance, Tiwari et al. (2023) found that eco-literacy has a positive impact on green purchasing attitudes and intentions. Besides, Liu and Tobias (2024) investigated environmental literacy (e.g., green products, material recycling, biodiversity conservation, and efficient use of energy), where all four dimensions positively impact green consumption behavior. In addition, Bhutto and Rūtelionė (2024), who tested eco-literacy as a moderator, found that eco-literacy can help reduce the risk and barriers, aligning with the studies of Li et al. (2024) and Shimul and Cheah (2023), which highlighted the importance of environmental knowledge (eco-literacy) as a precursor toward sustainable and responsible consumption.

Based on this evidence, this study proposes that eco-literacy may serve as a moderator between green marketing communication and consumer behavior. As denoted by Signaling Theory, the sustainable messages (signals) delivered by firms can be received more effectively by consumers with high ecological knowledge, reinforcing their green purchase behavior (Nabivi, 2025). Indeed, Bordian et al. (2023) found that green-integrated marketing communication positively affects ecological knowledge, while Rai et al. (2025) demonstrated that eco-literacy moderates the effect of environmental consciousness on energy-efficient appliance usage. With the support of these findings, the following hypothesis is postulated:

H5: Eco-literacy moderates the relationship between green marketing communication practices, namely (a) eco-labels, (b) green advertising, (c) social media marketing, and (d) green UGC, and green purchasing behavior, such that the positive impact of green marketing communication practices on green purchasing behavior is stronger when eco-literacy is high.

Figure 1 presents the research framework.

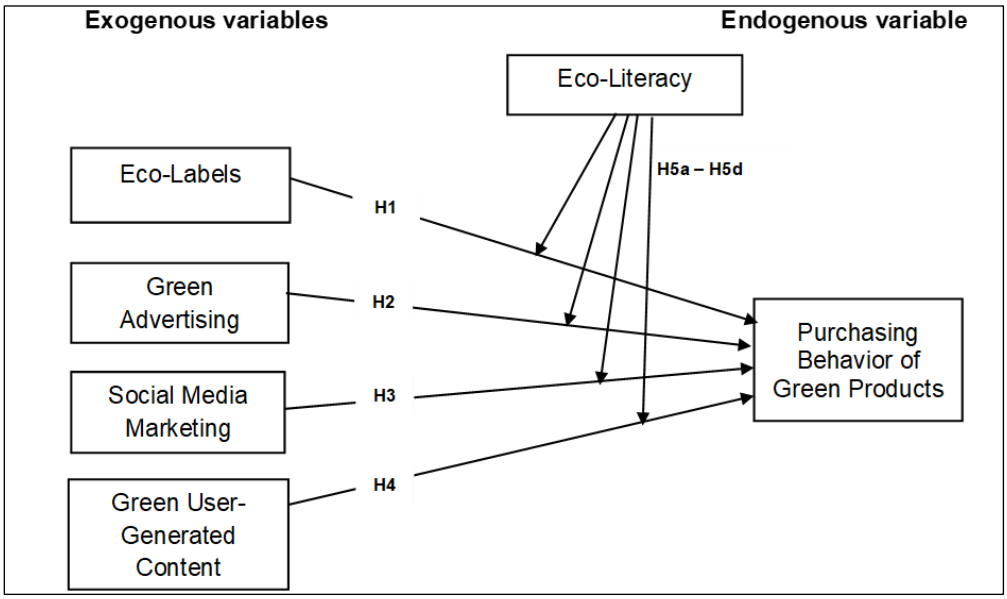

Figure 1 : Proposed Conceptual Framework

3.0 Methodology

3.1 Research Design

A quantitative research approach was considered most suitable for this study, as it required numerical data and statistical analyses to verify the hypothesized relationships (Lim, 2025). Given its cost-effectiveness, accessibility, and convenience, an online survey was used to collect data from the target respondents.

3.2 Sampling Technique and Sample Size

This study implemented purposive sampling, which involves targeting and selecting individuals or groups of individuals who are knowledgeable about the phenomenon and fulfill the specific criteria. Firstly, the researchers targeted Malaysian consumers aged 21 to 43 years as millennials and post-millennials are generally more environmentally conscious than other generational cohorts (Nadanyiova et al., 2020), making them more inclined to engage in green purchasing behavior. Furthermore, the study only focused on respondents who reside in the Klang Valley, as there is a higher demand for green products in urban areas (Martins, 2022). Third,

participants of this study have been avid purchasers of green products or have invested in green products previously, as the participants need to have a fundamental environmental awareness and understanding of green purchasing (Rashid & Lone, 2024). Lastly, the participants must be social media users who have personal insights into digital interactions and information dissemination on green products (Venciute et al., 2023).

To determine the required sample size, G*Power 3.1.9.6 software was applied (Memon et al., 2020). Based on the calculations of G*Power, the minimum sample size for this study is 114 respondents (effect size: 0.15; power: 0.80; number of predictors: 9), but this study has a valid 183 responses, which is sufficient for data analysis.

3.3 Instrumentation

The first section consists of three screening questions to ensure the participants meet the criteria to complete the survey. This includes whether the participant is 21 - 43 years old, a social media user, and possesses a purchasing history of green products. This section is vital to guarantee the accuracy of the data. The second section comprised demographic questions, such as gender, age, race, education, and income.

The third section measures the main variable of the *green marketing communication practices*. For instance, a 3-item scale of *eco-labels* was adapted from Shabbir et al. (2020). Eco labels are defined as a certification system that identifies green products that are less harmful to the environment (Liu et al., 2023). A 5-item scale of *green advertising* was adapted from (Shi & Jiang, 2023). Green advertising is defined as effectively communicating a green message to create green awareness and promote green consumption behavior (Schmuck et al., 2018). Besides, a 5-item scale for *social media marketing* was adapted from (Kijek et al., 2019), and it is defined as the use of social media platforms to promote a company and its products (Sharma & Verma, 2018). *Green UGC* items were modified from Morra et al. (2018), which is defined as the information exchange and communication regarding green products or brands on social media platforms by consumer-to-consumer (Zhao et al., 2023). All the above constructs were measured using a 5-point Likert-type scale (1 = strongly agree and 5 = strongly agree).

4 items of *eco-literacy* were adapted from Finisterra do Paço et al. (2009). It refers to the individual's knowledge that helps in

developing an understanding that natural resources should be preserved to make the earth a better place for current and future generations (Khan & Kirmani, 2018). Lastly, 3 items of *green purchasing behavior* were adapted from Shi and Jiang (2023), and it is defined as the acquisition of goods and services that are environmentally friendly (Hlaváček et al., 2023), and this construct was measured using a 6-point Likert-type scale (1 = strongly agree and 6 = strongly agree). (Refer to the Appendix for the details).

3.4 Data Collection

The data collection was performed using Google Forms through various social media platforms, such as Instagram, Facebook, and WhatsApp. The relevance of the online data collection has been evidenced in the green marketing scholarship on its applicability (Correia et al., 2023; Ramany et al., 2022). Thus, before answering the survey, the respondents are notified that their responses will be used exclusively for research purposes, which is stated on the cover page of the Google Form. Besides, anonymity and confidentiality of the respondents' information were also granted by the researchers, who abided by the research ethics on human participation. The questionnaire was distributed from 18th March 2024 to 29th May 2024. A total of 203 responses were gathered; however, after filtering, only 183 valid responses were retained.

3.5 Data Analysis

The PLS-SEM is applied to this study as it is referenced by other studies in green marketing and purchasing behavior (Ramany et al., 2022; Salam et al., 2021). Correspondingly, SMART-PLS 4.0 is implemented to analyze the data through partial least squares structural equation modeling (PLS-SEM) (Cheah et al., 2024). Most importantly, the current study tests the framework based on the perspective of prediction, which justifies the use of PLS-SEM (Hair et al., 2022; Sarstedt et al., 2022). This has further supported the notion of Sharma et al. (2021) that the prediction analysis is timely in research as it provides new observations within and outside of the sample.

3.6 Common Method Variance

Common method variance (CMV) needs to be addressed before testing the measurement model (Podsakoff et al., 2024). As prescribed

by Memon et al. (2023), procedural measures (e.g., including informative cover letters, clear answering instructions, and creating precise instrument items with no double-barred) can help to reduce the CMV. The researchers applied the procedural measure by incorporating the social desirability items adopted from (Fischer & Fick, 1993) to be embedded in the online survey to reduce the bias from the single-source data. Besides, researchers applied full collinearity assessment with a marker variable as suggested by Memon et al. (2023). The result of Variance Inflation Factor (VIF) values (e.g., Eco Labels = 1.183; Eco-literacy = 1.305; Green advertising = 2.097; Purchase behavior = 1.984; Social media marketing = 1.831; Green UGC = 1.760) was below the threshold of 3.3 (Hair et al., 2022). Therefore, there were no serious CMV issues or biases in the dataset.

4.0 Results

The respondents mostly consist of females (61.2%), whilst male makes up 38.8%. The highest number of responses came from participants aged 21 to 25 (41.0%), while only 9.3% were between 40 and 43 years old. In terms of ethnicity, the sample consisted of Malay (47.5%), Chinese (30.1%), Indian (20.8%), and other races (1.6%), adequately reflecting Malaysia's multiracial population. Regarding educational qualification, more than half of the respondents held a Bachelor's degree (56.3%), followed by Master's degree holders (19.7%), Ph.D holders (2.7%), those with professional certificates (1.6%), and others (19.7%). In terms of monthly income, the majority group earned less than RM2000 (32.8%), followed by those earning RM3,001–RM4,000 (25.1%). Given that all respondents were buyers of green products, the income statistics suggest that Malaysians at all levels generally have the purchasing power to afford premium green products.

Table 1 : Demographic Profiles of Respondents (N=183)

Variables	Category	Frequency	%
Gender	Male	71	38.8
	Female	112	61.2
Age	21 - 25	75	41.0
	26 - 30	46	25.1
	31 - 35	29	15.8
	36 - 40	16	8.7
	>40	17	9.3

Variables	Category	Frequency	%
Race	Malay	87	47.5
	Chinese	55	30.1
	Indian	38	20.8
	Others	3	1.6
Education	Bachelor's Degree	103	56.3
	Master's Degree	36	19.7
	Ph.D	5	2.7
	Professional certificate	3	1.6
	Others	36	19.7
Income	<RM2000	60	32.8
	RM2,001 - RM3000	41	22.4
	RM3,0001 - RM4000	46	25.1
	RM4,001 - RM5000	25	13.7
	RM5,001 - RM6000	7	3.8
	>RM6000	4	2.2

4.1 Measurement Model Assessment

The first stage of PLS-SEM is the measurement model assessment, which tests the reliability and validity of the model, and it was assessed using Composite Reliability (CR) (Hair et al., 2022). As shown in Table 2, all variables achieved CR values above the threshold of 0.70, indicating satisfactory reliability (Hair et al., 2022).

Convergent validity refers to the extent a single item correlates positively with the reflective multi-item measure of a variable, and it was evaluated using Average Variance Extracted (AVE), with values above 0.50 considered acceptable (Hair et al., 2022). All constructs met these requirements, indicating that the items sufficiently explained the variance of their respective constructs (see Table 2). Therefore, the constructs' reliability and convergent validity were established.

Table 2 : Measurement Model Results

Variable(s)	Items	Loadings	CR	AVE
Eco-label	EL1	0.854	0.844	0.644
	EL2	0.746		
	EL3	0.803		
Eco-literacy	ELi1	0.818	0.897	0.686
	ELi2	0.850		
	ELi3	0.877		
	ELi4	0.763		

Variable(s)	Items	Loadings	CR	AVE
Green Advertising	GA1	0.794	0.911	0.672
	GA2	0.717		
	GA3	0.885		
	GA4	0.876		
	GA5	0.815		
Purchase Behavior	PB1	0.869	0.898	0.747
	PB2	0.900		
	PB3	0.821		
Social media marketing	SMM1	0.783	0.878	0.591
	SMM2	0.829		
	SMM3	0.741		
	SMM4	0.805		
	SMM5	0.675		
Green UGC	GUGC1	0.833	0.912	0.722
	GUGC2	0.892		
	GUGC3	0.875		
	GUGC4	0.796		

Discriminant validity is defined as the extent each construct is different from the other constructs (Hair et al., 2022), and it was assessed using the Heterotrait-Monotrait Ratio (HTMT). As reported in Table 3, all values were below the threshold of 0.85 (Lim, 2024), confirming that the constructs were distinct from one another. Hence, discriminant validity was achieved.

Table 3 : Discriminant Validity Results (HTMT criterion)

	EL	ELi	GA	PB	SMM	GUGC
EL						
ELi	0.381					
GA	0.518	0.412				
PB	0.494	0.540	0.707			
SMM	0.437	0.261	0.785	0.582		
GUGC	0.613	0.342	0.592	0.656	0.660	

Note: EL = Eco-labels; ELi = Eco-literacy; GA = Green advertising; PB = purchase behaviour; SMM = social media marketing; GUGC = Green user-generated content

4.2 Structural Model Assessment

To examine the structural model relationships under PLS-SEM, this study employed a bootstrapping procedure with 10,000 resamples (Becker et al., 2023). To begin, multicollinearity was confirmed not to

affect the structural model, as all VIF values ranged between 1.441 and 2.206, well below the recommended cut-off of 3.3 (Lim, 2024). The results in Table 4 indicated that eco-labels (β = 0.049, t = 0.758, p = 0.224) do not have a significant impact on green purchase behavior. Subsequently, green advertising (β = 0.300, t = 3.585, p = 0.000) shows a positive impact on green purchase behavior. In contrast, social media marketing (β = 0.062, t = 0.782, p = 0.217) did not show significant relationships with green purchasing behavior, but green UGC (β = 0.294, t = 3.692, p = 0.000) had a positive effect on green purchasing behavior. Thus, H2 and H4 were supported, while H1 and H3 were not supported.

To analyze the moderation of eco-literacy, this study employed a two-stage approach to create interaction terms (Henseler & Chin, 2010). As shown in Table 4, the interaction effect of eco-literacy and eco-labels (β = 0.096, t = 1.441, p = 0.075), green advertising (β = 0.032, t = 0.372, p = 0.355), and social media marketing (β = -0.015, t = 0.170, p = 0.433) toward green purchase behavior was not significant. Besides, although the interaction related to eco-literacy and green UGC was significant (β = -0.179, t = 2.071, p = 0.019), the relationship is negative. As eco-literacy increased, the effect of GUGC on purchase behaviour decreased from β = 0.40 to β = 0.10, which indicates that the hypothesis was not supported. Thus, H5a to H5d were not supported. A graphical representation of this moderation effect is provided in Figure 2. The graph shows that the relationship between green UGC and green purchasing behavior is stronger among individuals with low eco-literacy, but weaker among those with high eco-literacy.

The model's explanatory power was reflected by an R^2 value of 52.2%, indicating that the exogenous variables can explain more than half of the variance in the endogenous variable, i.e., green purchasing behavior. Following Cohen's (1988) guidelines, effect size (f^2) values ranged from trivial to medium: eco-literacy and social media marketing had trivial effects (f^2 = 0.004), green advertising had a small effect (f^2 = 0.085), and green UGC demonstrated a medium effect (f^2 = 0.101).

Table 4 : Direct Effects

Paths	Std. Beta	Std. errors	T values	P values	LLCI (5%)	ULCI (95%)	D
H1: EL -> PB	0.049	0.065	0.758	0.224	-0.072	0.142	NS
H2: GA -> PB	0.300	0.084	3.585	0.000**	0.162	0.436	S
H3: SMM -> PB	0.062	0.079	0.782	0.217	-0.089	0.176	NS
H4: GUGC -> PB	0.294	0.080	3.692	0.000**	0.161	0.422	S
H5a: ELi x EL -> PB	0.096	0.067	1.441	0.075	-0.014	0.203	NS
H5b: ELi x GA -> PB	0.032	0.085	0.372	0.355	-0.114	0.167	NS
H5c: ELi x SMM -> PB	-0.015	0.089	0.170	0.433	-0.164	0.130	NS
H5d: ELi x GUGC -> PB	-0.179	0.087	2.071*	0.019	-0.325	-0.044	NS (-ve)

**p < 0.01, *p < 0.05; S= Supported; NS = Not supported
LLCL = Lower Level Confidence Interval; ULCL = Upper Level Confidence Interval
EL = Eco-labels; ELi = Eco-literacy; GA = Green advertising; PB = purchase behaviour; SMM = social media marketing; GUGC = Green user-generated content
1-tailed test

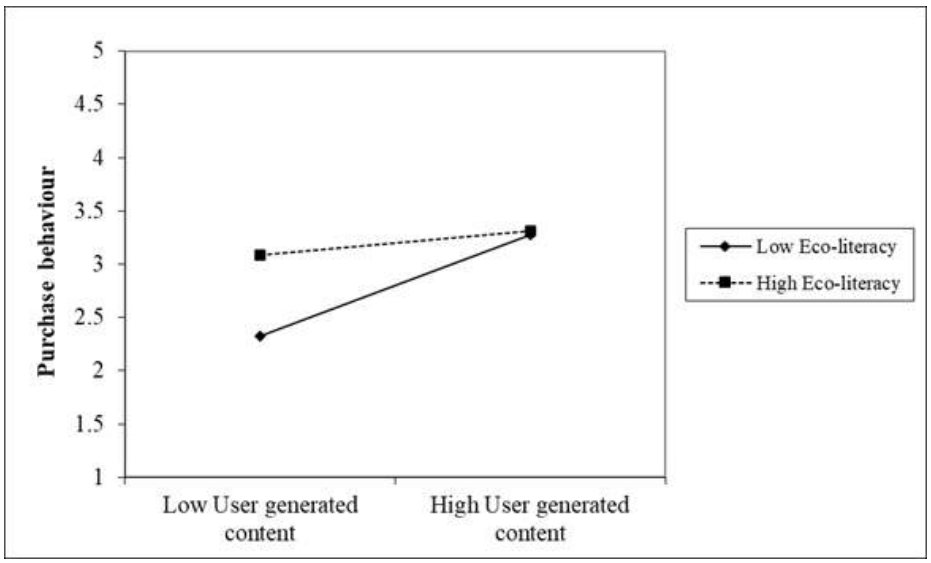

Figure 2 : Moderation Effect of Eco-Literacy Between Green UGC And Green Purchasing Behavior

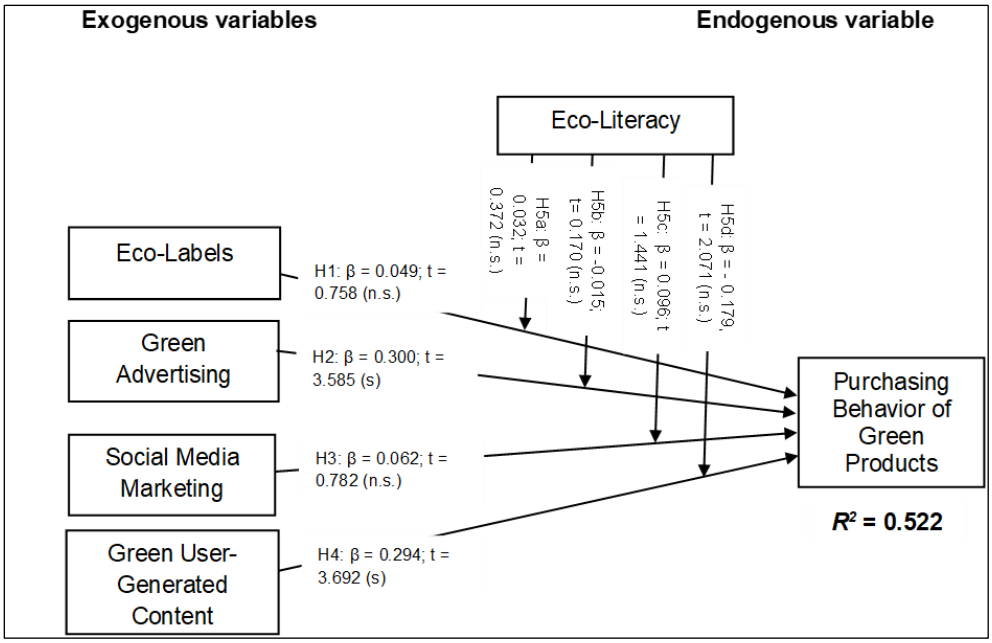

Figure 3 : Structural Model

In the final part of the structural model assessment, PLS Predict analysis was conducted as recommended by Shmueli et al. (2016). Variables can be substituted as a study evolves, particularly when researchers aim to assess out-of-sample prediction (Shmueli et al., 2019; Hair, 2020). As shown in Table 5, the majority of the prediction outcome errors for PLS-SEM were lower than the linear model, indicating that the current model has high predictive power for forecasting green purchasing behavior in the future.

Table 5 : PLS Predict Results

Items	Q^2predict	PLS-SEM_RMSE	LM_RMSE	PLS-SEM - LM
PB1	0.318	0.747	0.780	-0.033
PB2	0.306	0.823	0.903	-0.080
PB3	0.369	0.742	0.818	-0.076

5.0 Discussion

The results of this study indicate that eco-labels do not significantly predict green purchasing behavior (H1). The result contradicts previous research (Kumar & Basu, 2023; Mohamed Sadom et al., 2020). A possible explanation for this could be the demographic profile of the sample, where most respondents were young adults aged

21 to 25, who may lack awareness or understanding of green labels. Indeed, Yahya et al. (2022) argued that the meaning of eco-labels remains vague for some Malaysian consumers; as a result, they have various interpretations of these labels, with some even perceiving them as a greenwashing strategy used by companies to influence consumer perception (Haribhakti & Pandya, 2023).

Nonetheless, green advertising was found to have a positive and significant impact on green purchasing behavior (H2). Consistent with prior studies (Shi & Jiang, 2023; Khandelwal & Singh, 2023), the positive relationship is likely due to coherent and transparent communication regarding the environmental benefits of products, which builds consumer trust. In line with Signaling Theory, green advertising reduces information asymmetry, ultimately motivating consumers to make sustainable choices and purchase green products.

Meanwhile, the study found no significant relationship between social media marketing and green purchasing behavior (H3). This finding contradicts those of Armutcu et al. (2023) and Jain et al. (2020), who highlighted the positive effects of digital green marketing. One possible explanation is that social media platforms are oversaturated with high volumes of content, making it difficult for green marketing messages to stand out and reach target audiences (Bulmer et al., 2024). As social media becomes increasingly commercialized, green messages may even be blurred or perceived as insincere.

On the other hand, green UGC showed a significant positive impact on green purchasing behavior (H4). This finding supports the work of Geng and Chen (2021) and Panopoulos et al. (2023) that UGC is considered a more trustworthy public source of information in the virtual world, as it is not sponsored by profit-making organizations, green brands, or paid endorsers who seek to manipulate the real benefits of green products (Cheung et al., 2022; Santos, 2022). This transparency enables consumers to make more informed decisions and motivates them to adopt sustainable consumption behaviors.

The moderation analysis results indicate that eco-literacy does not affect the path of eco-labels and purchase behavior (H5a). This is contradicted by the findings of Bhutto and Rūtelionė (2024), who found that eco-literacy can help reduce the negative impacts of risks and barriers and promote purchasing behavior. The possible explanation is that the current samples of the study lack literacy on green and sustainable matters, which supports the notion of Norkhaidi et al. (2021) that the level of eco-literacy in Malaysia remains relatively low.

Furthermore, the results also demonstrated that eco-literacy is not able to moderate the path between green advertising and purchase behavior (H5b). This contradicted the results of (Bhutto & Rūtelionė, 2024; Rai et al., 2025), where they found that eco-literacy was the potential moderator. The insignificant result can be explained by the fact that Malaysian eco-literacy remains limited. Thus, the green-advertised message has to be coupled with other emotional appeals to stimulate pro-environmental behavior (Shimul & Cheah, 2023).

Besides, the moderating effect of eco-literacy on social media marketing and green purchasing behavior was also not significant. This contradicts the studies of Bhutto and Rūtelionė (2024) and Shimul and Cheah (2023), that consumers' behavioral responses to these green marketing communication practices do not rely on their eco-literacy level, which is also consistent with the findings of Liu and Tobias (2024). The possible explanation could be due to the high traffic on social media, which caused the message to be blurred and interfered by other information (noise), resulting in insignificant results.

Interestingly, the only significant moderation effect of eco-literacy was found between green UGC and green purchasing behavior, albeit in a negative direction; it implies that the relationship weakens among individuals with high eco-literacy. A possible reason is that the current sample consisted mainly of well-educated individuals. For such individuals, prior knowledge and environmental awareness may already guide their consumption choices, making green UGC signals less impactful (Correia et al., 2023). These observations support the notion that for eco-literate consumers, green purchasing behavior is driven by intrinsic rather than extrinsic factors.

6.0 Conclusion

In conclusion, green advertising and green UGC emerge as the two green marketing communication practices that significantly increase green purchasing behavior. In contrast, eco-labels and social media marketing do not affect such behavior. The moderating role of eco-literacy exists between green UGC and green purchasing behavior, but the relationship was negative, which explains that eco-literacy does not moderate the path between green marketing communication practices and purchase behavior.

6.1 Theoretical Implications

This study contributes to the understanding of the Signaling theory with green purchasing behavior. The results confirm that green advertising and green UGC are perceived as credible and trustworthy signals by consumers. Furthermore, it highlights their role in reducing information asymmetry between businesses and consumers regarding environmental practices (Bafera & Kleinert, 2022). Therefore, this study provides a further perspective on Signaling theory and green purchasing behavior (Bakış & Kitapçı, 2023; Liao et al., 2020) in the emerging market. The study is unique and provides a novel idea for sustainability marketing research as it looks from the angle of green marketing communication practices, which is timely due to the advancement of social media (Crapa et al., 2024; Nabivi, 2025), as compared to the previous studies, which mainly focused on green marketing practices.

6.2 Practical Implications

The study found that green advertising is the most effective factor in impacting green purchasing behavior. Hence, businesses can advance their advertising through transparent and credible green messaging to overcome the threat of greenwashing and skepticism. For instance, green product businesses can emphasize and promote the green identity through various social and print media (e.g., newsletters, press releases, brochures, posters) as a form of a message to project the quality and function of green products.

In addition, since green UGC was found to enhance purchasing behavior, businesses should encourage consumers to share genuine testimonials about their green product experiences. Consumer-generated messages on social media are more convincing than brand-generated content, making the green message more appealing and helping it stand out amid the digital noise.

Notably, policymakers and government regulators should take the initiative in addressing the safety and authenticity of green products to protect consumers from misleading green information. For instance, policymakers can enforce relevant policies and certifications like the MyHIJAU Mark as part of government-endorsed recognition schemes. Educational campaigns should also be launched to spread awareness about environmental concerns and best practices, thereby promoting

citizens' eco-literacy and normalizing sustainable consumption habits in Malaysia.

6.3 Limitations and Recommendations for Future Study

This study is subject to several limitations. First, it focused on green products in general. Scholars could gain more beneficial insights into green consumer behavior by investigating specific green product categories (e.g., clothing and home appliances). Second, this study was entirely based in the Malaysian setting. Considering cultural, social, and economic differences, cross-country comparisons of the research framework could reveal diverse findings and contribute to a better understanding of green consumer behavior across regions. Third, while this study's sample was sufficient for PLS-SEM's requirements, its relatively small size restricts generalizability due to the purposive sampling. Future research should aim for a larger and more diverse sample of green consumers to enhance the representativeness of the findings. Finally, we introduced social media marketing and green UGC into the green marketing communication model in this study. Researchers could further expand this framework by adding other independent or mediating variables such as consumer altruism (Signes et al., 2023), consumer attitude (Rousta & Allaf Jafar, 2024), consumer awareness (Rodrigo & Mendis, 2023), and gender (Rai et al., 2025). These linkages may yield different perspectives on green purchasing behavior and enrich the sustainability marketing literature.

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Appendix

Variable(s)	Items	Sources
Eco-Labels	EL1: Eco-labels are eye-catching on green products. EL2: Sufficient green information is provided on eco-labels. EL3: Information on eco-labels is accurate for green products.	Shabbir et al. (2020)
Green Advertising	GA1: I tend to pay attention to advertising messages that talk about the environment. GA2: The use of green messages in advertising affects my attitude toward green products. GA3: I respond favorably to products that use green messages in their advertising. GA4: I am the consumer who responds favorably when products use green messages in their advertising. GA5: I tend to pay attention to green advertising messages.	Shi and Jiang (2023)
Social Media Marketing	SMM1: I like browsing social media in the quest for green products. SMM2: I like browsing social media in the quest for ideas for buying green products. SMM3: I often browse the opinions and comments posted on social networks when deciding on the purchase of green products. SMM4: The social media I use helps me find more green products. SMM5: After browsing social media, knowledge of green products is increasing.	Kijek et al. (2020)
Green User-Generated Content	GUGC1: I am satisfied with the social media content generated by other users about green products. GUGC2: The social media content generated by other users on social media sites about green products meets my expectations. GUGC3: The social media content generated by other users on green products is very engaging. GUGC4: Social media content generated by other users on green products popularized my knowledge of environmental protection.	Morra et al. (2018)
Eco Literacy	ELi1: I understand the phenomenon of global warming. ELi2: I know what acid rain is. ELi3: I know the causes and effects of ozone depletion. Eli4: I know that plastic bags take many years to decompose and cause pollution.	Paco et al. (2009)

Variable(s)	Items	Sources
Green Purchasing Behaviour	PB1: I intend to purchase the green products because of the environmental concern. PB2: I expect to purchase the green products in the future because of their environmental performance. PB3: Overall, I'm glad to purchase the green products because they are environmentally friendly.	Shi and Jiang (2023)