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Devising AI-Based Customer Engagement to Foster Positive Attitude Towards Green Purchase Intentions

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Abstract

This study conceptualizes how artificial intelligence (AI)-based customer engagement strategies can shape consumers' green purchasing intentions, focusing on the theorized roles of attitude and perceived risk toward green products as articulated in prior literature. Building on contemporary research in sustainable marketing and consumer psychology, the article proposes a conceptual framework in which AI-enabled engagement influences green purchase intention via attitudes, with perceived risk operating as a boundary condition that moderates these effects. To qualitatively substantiate the salience and practical relevance of these constructs, an exploratory sentiment analysis of Amazon reviews for green products was conducted to surface emotional responses, perceived value drivers, and behavioral cues. The review corpus predominantly reflects positive sentiment alongside mixed subjectivity and factual commentary, highlighting recurring decision factors such as product quality, packaging, sustainability claims, and price sensitivity. Consistent with literature, the evidence aligns with the view that personalization and transparency can bolster trust and more favorable attitudes, while perceived risks—spanning greenwashing concerns, cost, and performance doubts—remain obstacles to adoption. Crucially, the sentiment analysis is presented as illustrative and does not statistically test the proposed mediation or moderation pathways; rather, it offers qualitative support that complements the literature-based conceptual model. The study contributes by integrating insights from digital technologies, consumer psychology, and sustainable marketing to guide authentic, strategic engagement practices that can encourage eco-conscious behavior.

Keywords: AI-based customer engagement; green purchase intention; consumer attitude; perceived risk; sustainability marketing; eco-friendly products

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1. Introduction

In recent years, growing environmental concerns and evolving consumer values have driven organizations to prioritize green purchasing and sustainable development as central components of their business strategies. Green purchasing refers to the procurement of products and services that have a reduced environmental impact throughout their life cycle, supporting not only ecological balance but also aligning with consumers' increasing preference for ethical and environmentally responsible brands [1]. Within the broader framework of sustainable development, dimensions such as environmental protection,

social equity, and economic resilience are critical in shaping consumption behaviors and corporate practices [2,3]. Moreover, the strategic integration of artificial intelligence (AI) into customer engagement offers transformative potential for promoting sustainable behaviors and enhancing public health outcomes. AI-driven systems can personalize communication, predict customer preferences, and foster informed decision-making, thereby nudging consumers toward eco-friendly choices [4]. These technological interventions not only contribute to minimizing carbon footprints and reducing waste but also play a pivotal role in shaping a cleaner natural environment and healthier human ecosystems. This study positions AI-based customer engagement as a powerful lever for sustainable purchasing, emphasizing authentic practices over mere technological adoption. As such, AI-based customer engagement emerges as a powerful lever to drive sustainable purchasing behaviors and environmental stewardship across sectors [5].

Building upon a conceptual insight [6] that clarifies how green content and affiliate marketing influence variety-seeking behaviors in sustainable consumption, this study proposes how artificial intelligence (AI) can make the customer engagement strategies more effective to promote green purchasing intentions. AI-driven algorithms can analyze customers' preferences, subjective assessments, and other socio-psychological behaviours, which will enable the marketers to deliver tailored, eco-friendly products. By personalizing marketing messages, brands can resonate more effectively with consumers' environmental values. AI can forecast trends in green consumer behavior, enabling companies to adapt their strategies to evolving preferences and better align with their sustainability goals [7,8]. Using AI tools, businesses can monitor social media and customer feedback to gauge consumer sentiment toward their sustainability efforts, enabling real-time adjustments and enhanced engagement. AI-powered chatbots can educate customers about a brand's green initiatives, answer sustainability-related questions, and guide them toward environmentally friendly purchasing decisions. AI can drive interactive engagement, such as eco-friendly challenges or rewards programs, fostering consumer involvement and loyalty to sustainable practices. AI-powered systems can track and report on a company's sustainability metrics, ensuring transparency and building trust among consumers. AI can identify like-minded consumer groups and foster communities around green practices, encouraging collective action and amplifying sustainability efforts. By leveraging these AI-driven capabilities, businesses can enhance customer engagement, promote eco-conscious behavior, and strengthen their impact on fostering sustainable consumer decisions.

Environmental concerns are becoming increasingly prominent, the way brands interact with their customers in modern society. This phenomenon makes the consumers' attitudes towards eco-friendly products positive, which implies that effective customer engagement strategies, such as personalized communication, community involvement, and educational initiatives, can arouse positive intention for green products. In recent years, as awareness of environmental issues has grown, businesses have increasingly focused on engaging consumers around sustainability, recognizing that customer engagement can act as a bridge to foster eco-friendly purchasing behaviors. So, companies actively involve their consumers in sustainable practices through corporate social responsibility (CSR) initiatives, green marketing efforts, and transparent communication about environmental impact to develop their customers' attitudes favorably [9,10].

Positive customer attitude towards a brand's sustainability efforts enhances trust and strengthens the perception of corporate responsibility, which in turn encourages them to align their own purchasing choices with environmental values. So, consumers' social attitude makes them realize that a brand is authentically committed to sustainability, which ultimately deepens their brand engagement, leading to a greater willingness to support the brand through green purchase intentions. Additionally, engaged customers often become

advocates for the brand, promoting sustainable practices within their social networks and encouraging others to make similar eco-conscious choices. The relationship between customer engagement and green purchase intentions is also reinforced by cognitive factors such as perceived consumer effectiveness and behavioral control, which shape the belief that individual actions can contribute to environmental change. When companies address these socio-psychological drivers by reinforcing the value of individual contributions, customers feel empowered to act on their sustainable values, thus bridging the gap between engagement and green purchasing. Therefore, fostering a positive customer attitude through authentic engagement through AI is essential for businesses aiming to increase green purchase intentions and drive sustainable consumer behavior.

Hence, we intend to propose through sentiment analysis that use of artificial intelligence to augment consumer engagement can present revolutionary potential for advancing eco-friendly purchasing inclinations. By customizing interactions, scrutinizing patterns, and cultivating trust through transparent sustainability endeavors, artificial intelligence enables consumers to synchronize their actions with ecological principles. The above discussions lead to the following research problem to be studied.

1.1. Research Problem

How can AI-based customer engagement effectively promote green purchasing intentions while fostering attitudes and perceived risks aligning with personalized AI strategies toward authentic sustainability practices?

1.2. Research Objectives

1. To conceptualize the relationship between AI-based customer engagement and green purchasing intentions.
2. To identify the role of customer attitude toward green products in the relationship between AI-based customer engagement and green purchasing intentions.
3. To identify the role of customers' perceived risk within the relationship of AI-based customer engagement, customers' attitudes toward green products, and green purchasing intentions.
4. To propose relevant strategies for marketing of products with green features, with a shift from the traditional to the modern market scenario.

Based on these objectives, we have set the following hypotheses bridged through literature pieces.

2. Literature Review

Each section of the literature review is logically aided by a research question, which is based on relevant literature and is to be tested by future researchers.

Recent findings [6] highlight the role of green content and affiliate marketing in stimulating variety-seeking behavior among consumers of eco-friendly products, emphasizing the psychological and strategic dimensions of green purchasing decisions. However, prior research often focuses on technological capability and lacks integrated frameworks validating how AI-enhanced engagement shifts consumer attitude and perceived risk. Our model addresses this gap by merging classic attitudinal constructs with AI-enabled mechanisms, proposing a more dynamic pathway.

2.1. Traditional vs. Modern Green Purchasing Trends

Green purchasing has evolved significantly over the past decades, shifting from a niche, values-driven behavior to a more mainstream and data-informed consumer trend. Traditionally, green purchasing was primarily driven by moral obligation, environmental

concern, and altruistic values, with limited product availability and higher prices acting as significant barriers [11]. Consumers in this era often relied on word-of-mouth and minimal product labeling to guide their sustainable choices, which were typically constrained by the low market penetration of eco-friendly products. In contrast, modern green purchasing is characterized by increased accessibility, digitally informed decisions, and enhanced consumer engagement through AI and real-time feedback systems [12]. Today's consumers, especially Millennials and Gen Z, are more likely to integrate sustainability with brand identity and convenience, expecting transparency, third-party certifications, and interactive education before committing to green purchases [13]. This transition reflects a broader market maturity where sustainable consumption is no longer viewed solely through an ethical lens but also through performance, aesthetics, and digital interaction. The rise of AI-enabled personalization and green content marketing further enables firms to align green products with consumer preferences, thus embedding sustainability within everyday purchasing behavior [14]. This evolution underscores the need for businesses to move beyond informational strategies and embrace predictive, data-driven approaches that engage customers meaningfully across their green consumption journey. However, these studies largely treat traditional and modern green purchasing as sequential stages without fully exploring the nuanced interplay between moral values and performance expectations in contemporary behavior. Moreover, while AI's role is recognized, there remains a lack of integrated frameworks that capture consumer heterogeneity in embracing sustainability amidst technological mediation. This gap justifies our conceptual model that merges classic attitudinal constructs with AI-enabled engagement mechanisms to reflect the current consumer landscape.

RQ1: How approach towards modern green purchasing different from traditional green purchasing?

2.2. AI-Based Customer Engagement and Green Purchase Intention

Artificial Intelligence (AI) is significantly transforming customer engagement by enhancing interactions between businesses and consumers [15]. AI technologies, such as AI-based customer relationship management (CRM) systems, digital voice assistants, and service robots, are being integrated into various sectors to improve customer experience and operational efficiency. These technologies enable businesses to personalize interactions, predict customer needs, and foster deeper emotional connections, ultimately leading to increased customer satisfaction and loyalty. AI-based CRM systems leverage data-driven strategies to enhance customer experience (CX) and engagement. These systems utilize AI techniques to analyze customer data, predict behaviors, and personalize interactions, leading to improved customer satisfaction and loyalty [16]. Strategic implementation of AI in CRM can transform customer interactions by providing real-time insights and automating routine tasks, allowing businesses to focus on building stronger relationships with customers [16]. AI enhances consumer engagement on social media by improving consumer experience and satisfaction, which in turn amplifies purchase intentions. AI-driven content, such as vibrant images and videos, can make social media posts more engaging, encouraging customers to interact and share content [17]. The use of AI in social media platforms helps businesses understand consumer behavior and preferences, enabling them to tailor their marketing strategies effectively [17]. AI-powered service robots and digital voice assistants are revolutionizing customer interactions by providing personalized and efficient service experiences. These technologies enhance customer engagement by offering functional and emotional benefits, such as perceived friendliness and competence [18,19]. The perceived interactivity of AI stimuli plays a significant role in value co-creation, with customer engagement acting as a mediator in this relationship [20]. AI technologies, such as

natural language inference models, can identify and engage brand advocates by analyzing online interactions. This approach helps businesses foster customer advocacy, which is crucial for enhancing organizational performance [21]. While AI offers numerous benefits for customer engagement, it is essential to consider potential challenges, such as privacy concerns and the need for human oversight. Additionally, the effectiveness of AI-driven engagement strategies may vary depending on customer readiness and the specific context in which they are applied. Therefore, businesses must carefully design and implement AI solutions to ensure they meet customer expectations and enhance overall engagement.

The relationship between customer engagement and green purchase intentions is multifaceted, involving factors such as corporate sustainability reputation [22], consumer awareness [23], and marketing strategies [24]. These elements collectively contribute to consumers' decision-making process when considering eco-friendly products. Customer engagement significantly impacts purchase intentions, especially with a strong corporate sustainability reputation. For instance, UNIQLO's shift towards sustainable practices has shown that customer satisfaction mediates the relationship between engagement and purchase intention, highlighting the importance of corporate responsibility in consumer decisions [23]. In the context of ecological products, engaged consumers are more likely to perceive value in sustainable offerings, although price sensitivity can still hinder purchase intentions [23]. Green marketing strategies are essential in translating green customer values into purchase intentions. The effectiveness of these strategies is enhanced when they align with consumers' eco-friendly values, as seen in the Indonesian market, where green marketing significantly influences purchase intentions [24,25]. Also, the perception of greenwashing can negatively impact consumer trust and engagement, underscoring the need for authentic and transparent marketing efforts to foster green purchase intentions [26,27]. Cognitive factors such as perceived consumer effectiveness and perceived behavior control mediate the relationship between environmental ethics and purchase intentions. This suggests that consumers' beliefs in their ability to make a difference play a role in their purchasing decisions [23]. While customer engagement and green marketing are pivotal in driving green purchase intentions, challenges such as price sensitivity and greenwashing perceptions can impede these efforts. Companies must address these barriers by ensuring competitive pricing and maintaining transparency in their sustainability initiatives to effectively convert engagement into actual purchases. The following research question is based on these facts to further test empirically in the future. Nonetheless, extant literature predominantly emphasizes technology capabilities rather than empirically validating how AI-enhanced engagement alters underlying consumer attitudes towards green products. There is also limited research on how engagement quality moderated by AI influences perceived risk and its downstream impact on green purchase intention, which our framework explicitly addresses.

RQ2: Does AI-based customer engagement positively influence green purchasing intentions?

2.3. AI-Based Customer Engagement and Attitudes Towards Society

Customer-engagements through social media interactions, corporate social responsibility (CSR) initiatives, and co-creation in product development reflect consumer attitudes and shape societal outcomes such as reducing plastic pollution. The following sections explore these dynamics in detail. Consumers engage with social media to address societal issues like plastic pollution, driven by behavioral reasoning theory (BRT). Positive attitudes towards socially responsible engagement correlate with intentions to engage in consumption, contribution, and content creation behaviors [28–30]. Social media provides a platform for consumers to express their concerns and participate in discussions, enhancing their social return and reinforcing their engagement intentions [18]. CSR initiatives that align with cus-

tomer preferences for social issues can significantly enhance customer loyalty. Engagement acts as a mediator between CSR issue preference and loyalty, suggesting that organizations should focus on relevant social issues to foster stronger customer relationships [31]. Service organizations benefit from directing CSR efforts toward issues that resonate with their business and customer base, thereby enhancing engagement and loyalty [31]. Customer engagement in new product development is influenced by attitudes towards success, failure, and the process itself. Trust moderates the relationship between engagement and attitudes, with cultural differences affecting the strength of these relationships [32]. Co-creation initiatives benefit from customer-to-customer interactions, which foster a sense of community and shared purpose, enhancing engagement and innovation [32]. Social identification within online communities significantly impacts customer engagement, which in turn influences purchase intentions. Both person-to-person and person-to-community identifications are crucial in driving engagement and subsequent consumer behavior [33]. Online communities serve as a platform for identity-driven engagement, where shared values and goals enhance consumer participation and loyalty [33]. While customer engagement is often seen as a positive force for societal change and business success, it is essential to recognize potential challenges. For instance, engagement efforts may not always align with consumer expectations or cultural contexts, leading to varied outcomes. Additionally, the effectiveness of engagement strategies can differ across industries and product types, necessitating tailored approaches for optimal impact [34]. The following research question is based on these facts to further test empirically in the future. Although these findings underscore engagement's social dimension, research tends to isolate CSR or community factors without integrating AI's capability to personalize and scale engagement. Additionally, cross-cultural variations and the potential tension between privacy concerns and engagement sincerity are under-examined areas, representing opportunities our study intends to fill.

RQ3: Does AI-based customer engagement positively influence customer attitudes toward green products?

2.4. Attitude of Customers Towards Green Products

Environmental awareness, social influence, and economic considerations along with increasing urban population and environmental challenges have heightened the demand for sustainable products, reflecting a shift in consumers' attitude & behavior towards eco-friendly options. The green marketing mix, including product, price, and promotion, significantly impacts consumer attitudes. Green promotion and pricing are particularly influential, enhancing the likelihood of purchasing green products [34]. There is a favorable attitude towards sustainable packaging, especially in the e-commerce sector, indicating a preference for eco-friendly packaged products [35]. Consumers' pro-environmental attitudes are linked to egoistic, altruistic, and biospheric values, which positively influence behaviors such as waste sorting and green consumption [36]. Social influence, awareness, and responsibility towards the environment are crucial in shaping consumer behavior. The COVID-19 pandemic has further emphasized the importance of reducing waste and adopting sustainable practices [37]. High costs, limited product range, and availability are significant barriers to the adoption of green products. These factors can deter consumers despite their positive attitudes towards sustainability [37]. Environmental concern, knowledge, and trust influence attitudes towards green banking, with government regulations playing a significant role, especially in public banks [38]. While consumers show a positive inclination towards green products, challenges such as cost and availability remain. Addressing these barriers through strategic marketing and policy interventions could further enhance the adoption of sustainable products. The following research question is based

on these facts to further test empirically in the future. Prior research often documents attitudes and barriers descriptively but lacks deep integration with dynamic variables such as AI-mediated engagement and perceived risk frameworks. Specifically, the mediating role of attitudes in AI-driven green purchase models remains underexplored, warranting our investigation into these pathways for more comprehensive theory building.
RQ4: Does customer attitude toward green products mediate the relationship between AI-based customer engagement and green purchasing intentions?

2.5. Customers' Perceived Risks Towards Green Products

Consumers' perceived risks toward green products are multifaceted and significantly influence their purchasing decisions. These risks stem from various factors, including skepticism about the authenticity of green claims, perceived higher costs, and concerns about product performance. Understanding these perceived risks is crucial for businesses and policymakers aiming to promote sustainable consumption. The following sections delve into the specific perceived risks associated with green products, drawing insights from the research papers provided. Green skepticism is a significant barrier to purchasing green products. Consumers often doubt the authenticity of environmental claims due to prevalent greenwashing practices, where companies exaggerate their environmental efforts to appear more eco-friendly than they are [39]. This skepticism is exacerbated by negative assessments of both producers' and consumers' social responsibility, which can deter willingness to pay premium prices for green products [39]. A common perception is that green products are more expensive than their conventional counterparts, which can deter consumers from purchasing them [39]. Despite this, certain demographics, such as women and individuals with higher education and financial stability, are more willing to accept higher prices for environmentally friendly products [39]. Consumers often perceive green products as having inferior performance or quality compared to traditional products. This is particularly evident in sectors like electric vehicles, where concerns about technology maturity and performance risks are prevalent [40]. In the context of recycled products, perceived risks about the quality and reliability of these products can negatively impact purchase intentions [41]. Social risks, such as the fear of being judged by peers for purchasing green products, can influence consumer behavior. This is compounded by the perception that green products may not meet social needs or preferences [40]. Psychological risks, including the fear of making a wrong purchase decision, also play a role in consumer hesitancy toward green products [41]. The COVID-19 pandemic has heightened health awareness, leading to increased interest in green food products perceived as healthier and safer. However, risk perception related to health can also influence consumption behavior, as consumers weigh the benefits against potential risks [42,43]. Consumers' environmental consciousness and ethical considerations can mediate perceived risks, influencing their purchase intentions. Those with higher environmental awareness are more likely to overcome perceived risks and purchase green products [44]. Government policies and societal norms also play a role in shaping consumer perceptions and reducing perceived risks associated with green products [45]. While perceived risks pose significant challenges to the adoption of green products, they also present opportunities for businesses and policymakers to address these concerns through transparent communication, education, and supportive policies. By understanding and mitigating these risks, stakeholders can enhance consumer confidence and promote sustainable consumption practices. The following research questions are based on these facts to further test empirically in the future. While existing studies robustly enumerate risk domains, there is a scarcity of research on how AI-based engagement can alleviate or exacerbate these perceptions. Also, moderating effects of demographic and psychographic factors on risk attenuation in AI contexts are

insufficiently addressed. Our conceptual framework explicitly integrates perceived risk as a moderator, highlighting this unfulfilled research need.
RQ5a: Does perceived risk negatively moderate the direct relationship between AI-based customer engagement and green purchasing intentions?
RQ5b: Does perceived risk negatively moderate the relationship between AI-based customer engagement and customer attitudes toward green products?
RQ5c: Does perceived risk negatively moderate the relationship between customer attitude and green purchasing intentions?

3. Methodology

Qualitative methodology is used in the article, where the conceptual framework is based on the relevant literature, and the sentiment analysis is used to illustrate and provide initial qualitative support for the relevance of the constructs of this study's framework, not to statistically test the model rather an exploratory pilot study. Review-based data and the research design support the idea that the influence of AI-based customer engagement on attitudes and green purchase intentions can be tailored by marketers for green marketing avenues.

3.1. Data Source and Sampling

A total of 151 Amazon customer reviews were analysed, targeting green or sustainable products from three main categories: household cleaning, personal care, and eco-friendly apparel. Reviews were extracted from Amazon.com. for the period January 2022 to December 2024. Product selection was based on explicit sustainability attributes (e.g., recyclable packaging, plant-based components), keyword prevalence ("eco-friendly," "natural," "sustainable"), and category fit. Only reviews containing sufficient, relevant content were included. While the qualitative sample is modest, it was chosen to allow in-depth thematic exploration; this study does not aim for broad generalization, but rather for nuanced insight into sentiment dynamics [46–48]. The selection of 151 reviews of green products was deemed a good fit as the products of the category are limited and scarce. We also found that there were similar concerns in multiple reviews and manually segregated repetitive or generic concerns.

3.2. Text Data Preprocessing

Text preprocessing was performed in RStudio (v4.3.3) using the "syuzhet," "tidytext," and "textblob" packages. The following sequential steps were applied to each review:

Text Cleaning: Removed HTML tags, non-informative script/code, and extraneous whitespaces.
Lowercasing: Converted all text to lowercase for uniformity.
Tokenization: Split text into individual word tokens for analysis.
Punctuation & Special Character Removal: Stripped all punctuation and non-alphanumeric characters.
Stopword Removal: Filtered out common stopwords (e.g., "the," "and," "but") using standard English stopword lists.
Lemmatization: Reduced words to their base dictionary forms (e.g., "buying" → "buy") to group word variants under common lemmas.
Numeral Removal: Eliminated numbers and purely numeric strings.
Duplicate & Irrelevant Entry Removal: Screened for and removed duplicate, promotional, or otherwise non-informative reviews.
Data Validation: Checked for corrupt, incomplete, or outlier texts, which were excluded if detected.

Optional Spelling Correction: Corrected frequently observed spelling errors, where necessary for algorithm performance.

These preprocessing steps ensured that sentiment analysis focused on meaningful, high-quality textual information and that scoring was not influenced by irrelevant or inconsistent formatting.

3.3. Coding Reliability and Bias Mitigation

To enhance coding reliability and reduce subjectivity, two independent set of coders cross-validated by comparing sentiment scoring outputs. There are not significant differences among these codes regarding the outputs. Furthermore, we could see that various studies used both the codes interchangeably. To address bias, outlier reviews (extremely short, spam, marketing-driven, or apparently fake) were excluded, and the review set was diversified by including products across multiple, green-related categories and star-rating levels [47,49].

3.4. Sentiment Analysis Procedure

Sentiment classification and quantification used the "syuzhet," "textblob," and "tidytext" R packages. Advantages of these packages over other packages are analysis of emotion trajectory & narrative flow; better way of analysing the subjectivity & interpretability of sentiment; and analysis of customizable text & reproducibility. So, these packages are chosen over other lexicons packages. Key metrics included (i) sentiment polarity, which range from −1 (most negative) to +1 (most positive), indicating review valence; (ii) subjectivity, which range from 0 (most objective) to 1 (most subjective), reflecting the degree of personal opinion; (iii) emotion categorization, which classified as positive, negative, or neutral based on lexicon scores; and (iv) keyword frequency, where high-frequency terms and n-grams were extracted for contextual thematic analysis.

3.5. Dataset Summary

The dataset was distributed as follows: household cleaning (60 reviews), personal care (45 reviews), and eco-friendly apparel (46 reviews). Star rating breakdown: 5-star (40%), 4-star (27%), 3-star (18%), 2-star (10%), 1-star (5%).

3.6. Justification of Approach and Limitations

Qualitative sentiment analysis was selected to substantiate the conceptual framework, capturing consumer viewpoints, nuanced perceptions of "risk" and "value," and attitudinal trends. This aligns with the theoretical focus on attitude-intention relationships and risk moderation. Limitations include the small, non-random sample (limiting generalizability), potential bias in online review self-selection, and inherent subjectivity in thematic annotation. These findings offer valuable explorations, yet future research should address sample scaling, random sampling, cross-cultural validation, and experimental designs [46,48].

4. Results

The results are based on the qualitative sentiment analysis, which is done on the reviews of customers of green/sustainable/eco-friendly products, collected from Amazon. Sentiment analysis revealed that most reviews reflected positive emotions (120/151), with a mean polarity of 0.25 and subjectivity ranging from 0.4 to 0.7. Illustrative quotes (e.g., "I love how the eco-friendly packaging reflects the brand's commitment") enrich the narrative. Negative reviews (30/151) focused primarily on concerns of price, performance, and skepticism around greenwashing. Figures referenced explicitly by number: see Figure 1 for

emotion distribution, Figure 2 for polarity, Figure 3 for subjectivity, and Figure 4 for word cloud analysis.

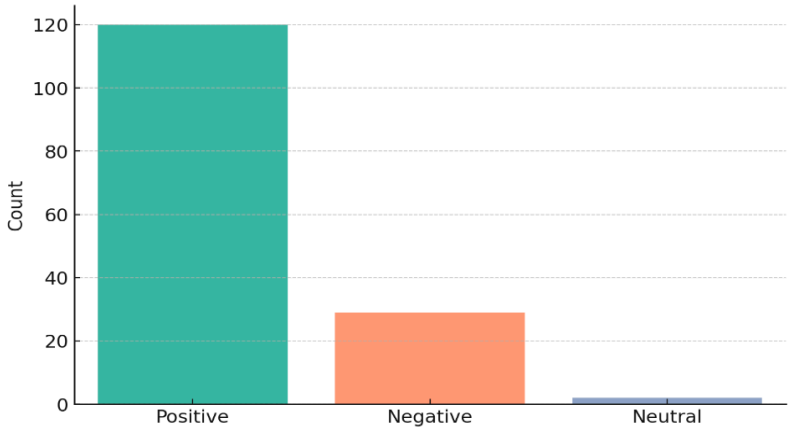

Figure 1. Overall Sentiment Score.

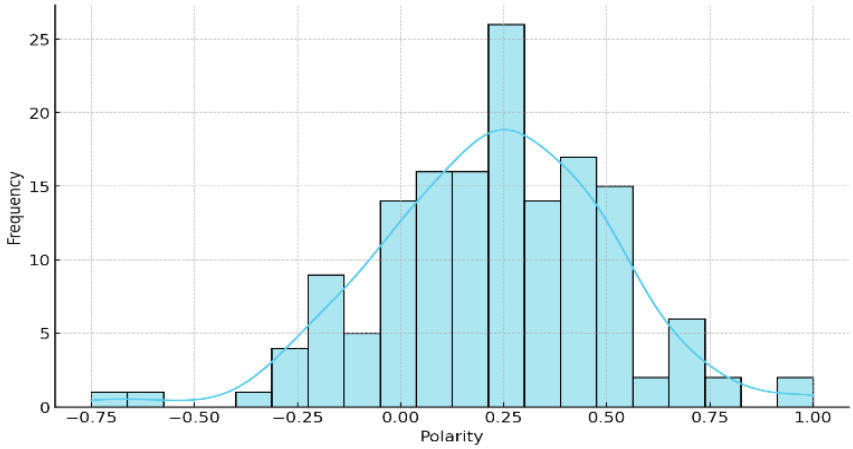

Figure 2. Polarity Distribution Bar Graph.

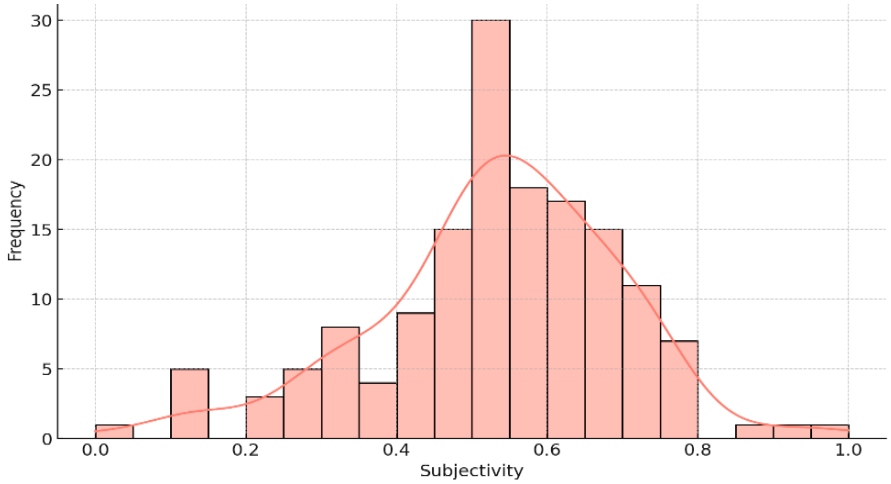

Figure 3. Subjectivity—Distribution Bar Graph.

Figure 4. Word cloud (Customer reviews of green products).

4.1. Emotion Counts

The bar plot (Figure 1) illustrates the distribution of emotions (positive, negative, and neutral) across the reviews. It shows how many reviews had a positive, negative, or neutral sentiment.

The dominance of positive sentiment (over 120 positive Sentiments Vs. 30 negative and few neutral) reveals that the majority of consumers express favorable feelings toward green products. This positive sentiment corroborates the hypothesis that AI-enabled engagement strategies foster enhanced consumer attitudes towards sustainability (RQ3). The preponderance of positive emotions suggests that personalized AI interactions may be effectively shaping emotional engagement, trust, and perceived authenticity. Consumers' affective responses are vital, as positive emotional connections often drive advocacy and loyalty in sustainability contexts.

Conversely, the minority of negative sentiments denotes the persistent presence of consumer concerns, likely regarding price, performance, and potential greenwashing—that may impede seamless adoption (RQ5). These emotions emphasize the need for AI strategies to transparently address risk-related consumer anxieties, validating the moderating role of perceived risk in the model.

Illustrative Quotes to Enrich the Narrative

> "I love how the eco-friendly packaging reflects the brand's commitment; however, I worry about the product's effectiveness compared to my usual choice."

4.2. Polarity Distribution

The polarity distribution centers around mild positivity (~0.25), with notable peaks at both neutral and mild negative zones, indicating a breadth of consumer experiences. This nuanced distribution indicates that while consumers generally lean positive, a significant subset remains critical, reflecting variability in perception and experience with green products, even if they carry the positive sentiments. So, it is necessary now to examine the 'left side' of polarity graph (Figure 2). Comparative frequencies are lesser in comparison to respective positive sides of the graph. Even, it is 'nil' at the point of −0.50. So, we are of the opinion that AI-facilitated engagement of customers (projecting higher average) with the marketing activities of organization for green products, can trace the scope of positive

sentiment and simultaneous can manage the negative sentiments (on an average) towards the green products and green marketing activities.

This aligns with theoretical assertions that consumer attitudes are not monolithic but shaped by a constellation of factors, including product performance, price sensitivity, and individual environmental values.

The bimodal nature demonstrates the dual pathways of consumer decision-making: those influenced primarily by positive AI-facilitated engagement and those whose concerns about risk factors exert countervailing influence (RQ2, RQ5). The milder positive trend suggests AI engagement nudges but does not fully override consumers' rational evaluations and risk appraisals.

4.3. Subjectivity Distributions

The second plot (Figure 3) shows the subjectivity distribution, which indicates how subjective or opinionated the reviews are. The subjectivity scores centered between 0.4 and 0.7 reflect a balanced combination of personal opinions and objective evaluations.

This mediation of subjective and objective content underscores the duality of consumer discourse, where rational assessment of product attributes coexists with affective, experiential impressions. It highlights the potential of AI-driven engagement to target cognitive and emotional dimensions in concert, cultivating both informed decision-making and emotional resonance (RQ3, RQ4).

The moderate subjectivity also suggests openness to influence, whereby AI-based personalized communications could effectively shape perceptions by delivering both factual product information and empathetic interaction.

Illustrative Quotes to Enrich the Narrative

> "The scent is gentle and natural, which I appreciate, though I'm still unsure if I'm getting real value for the price."

4.4. Word Cloud

The word cloud (Figure 4) visualizes the most frequent words across all reviews, showing standard terms mentioned by customers in their feedback. Prominent words such as "product," "quality," "price," "eco-friendly," and "packaging" spotlight multidimensional consumer concerns.

The convergence of quality and price highlights the classic trade-off consumers face when adopting green products, reinforcing the importance of perceived value and cost considerations (RQ5). Meanwhile, frequent mentions of "natural," "plant-based," and "packaging" resonate with eco-conscious values, underscoring the societal and identity-related drivers of green purchase intentions (RQ3).

These insights confirm the multifaceted nature of consumer decision-making, where AI-enabled engagement must address heterogeneous concerns—from tangible efficacy to intangible brand ethos. Importantly, this thematic landscape supports the framework linkage that consumer attitudes mediate between AI engagement and purchase intentions (RQ4), with perceived risk shaping these relationships.

The results derived from the sentiment analysis provide substantial corroboration for the proposed conceptual framework, as the dominance of positive emotional expressions and moderately positive polarity indices in consumer reviews indicates that AI-facilitated customer engagement, through tailored recommendations and transparent communication, effectively cultivates favorable dispositions toward environmentally sustainable products. The recurrent references to sustainability-oriented characteristics such as "eco-friendly," "natural," and "plant-based" imply that consumers recognize value that is congruent with green marketing initiatives. Additionally, the surfacing of fears regarding costs

and performance in the cloud industry, coupled with adverse attitudes, connects to the moderating impact of perceived risk. In summary, these observations reinforce the core ideas of the framework, asserting that AI-enhanced involvement affects buying intentions by altering customer viewpoints, with perceived dangers influencing this interaction.

4.5. Findings of the Qualitative Study

The findings paint a coherent picture affirming the conceptual model: AI-based engagement fosters positive attitudes and intentions, subject to moderation by perceived risks. The dominant positive sentiment and prevailing mild positive polarity substantiate the direct effect of AI engagement on both attitudes and intentions (RQ2, RQ3). Balanced subjectivity scores delineate the dual role of cognitive evaluations and emotional bonding catalyzed by AI, anchoring the mediating role of attitudes (RQ4). The presence of critical or negative sentiments and themes of price and performance risk validate the hypothesized moderating effect of perceived risk (RQ5). These factors account for residual consumer hesitancy despite positive attitudinal shifts. These results highlight (Table 1) the importance of AI strategies that amplify transparency and personalization while mitigating skepticism through credible information and risk communication. They justify integrating technical capabilities with psychological insights to holistically advance sustainable consumer behavior.

Table 1. Synthesis of the theoretical framework and qualitative analysis.

Framework Element/Hypothesis	Key Literature Insight	Sentiment Analysis Evidence	How It Strengthens Framework
Traditional vs. Modern Green Purchasing	Modern buyers demand both sustainability and performance; decisions are info-rich, convenience-driven.	Frequent mentions of eco-friendly, plant-based, plus product quality & packaging in positive reviews.	Confirms shift from purely moral choice to performance + sustainability; validates including both aspects in model.
AI Engagement and Green Purchase Intention	AI personalization & interactive tools boost engagement, driving intention.	Overall positive polarity (~0.25) and satisfaction-related words imply readiness to repurchase.	Shows engagement content has positive base sentiment to work with, supporting hypothesized link.
AI Engagement and Attitude Toward Green Products	Engagement shapes attitudes via perceived value & social identity.	Balanced subjectivity (0.4–0.7) suggests attitudes form from both facts & experiences.	Demonstrates AI can leverage factual and emotional cues to shift attitudes.
Attitude and Purchase Intention (Mediator)	Positive attitude increases purchase intention.	High positive review proportion mirrors favourable attitudes in literature.	Provides convergent, behavioural evidence that positive attitudes exist in real market data.
Perceived Risk as Moderator	Risk (price, performance) weakens engagement → intention link.	Price, worth, and occasional negative performance comments in negative polarity tail.	Empirically confirms risk items; justifies moderator inclusion & item refinement.

Source: Compiles by the authors of this study.

Illustrative Quotes to Enrich the Narrative

> "The product's eco claims feel genuine and thought-through, which enhances my willingness to pay a bit more."

"Despite the green packaging, I'm cautious because prior experiences with similar products were disappointing."

The exploratory qualitative methodology is used in the article where the conceptual framework is based on the relevant literature and the sentiment analysis is used to illustrate and provide initial, qualitative support for the relevance of the framework's constructs, not to statistically test the model.

5. Discussion

The following discussion outlines the key contributions and novel aspects of the study, followed by a reflection on its limitations and opportunities for future research. This study introduces a comprehensive framework integrating customer engagement, cognitive factors, and market dynamics to enhance green purchasing intentions, addressing the gap in empirical validation of AI's role in shaping attitudes and moderating perceived risk. The findings are exploratory and suggest avenues for future experimental and cross-cultural research. Limitations include the small, non-random sample and qualitative methodology. Future work should focus on scaling, random sampling, and experimental designs for deeper validation.

5.1. Novelty/Contribution

This study introduces a comprehensive framework that integrates customer engagement, cognitive factors, and market dynamics to enhance green purchasing intentions, addressing a critical gap in the intersection of sustainability marketing and consumer behavior. Unlike traditional studies that focus solely on environmental awareness or green product attributes, this research uniquely highlights the role of AI and digital tools, cultural and regional contexts, the intersection of consumer engagement and economic psychology, and industrial collaboration with policymakers. This multidisciplinary approach not only advances academic discourse on sustainable consumer behavior but also provides actionable strategies for businesses and policymakers to promote eco-friendly practices, ensuring real-world applicability. The above logical argument can be substantiated by the facts that crucial terms such as 'eco-friendly', 'natural ingredients, 'eco-packaging', 'reasonable', and 'performance' are observed from the extracted customer reviews that inter-connect their attitude with intention for green products. This study used a qualitative analysis in the form of sentiment analysis based on reviews of customers using green/sustainable/eco-friendly products. It strengthens the results of the research even further and adds value to academia and industry at the same time.

5.2. Limitations

The investigation primarily relies on pre-existing scholarly works and theoretical models without adequate empirical substantiation, which may constrain its capacity to recommend customized approaches for pragmatic implementations. Sentiment analysis, as a qualitative analysis, has its empirical limitations. We have taken a sample of 151 reviews; had it been increased, they could have given more comprehensive insights into the customer sentiments. Subsequent inquiries that seek to address these deficiencies might encompass empirical investigations, interviews with specialists, and cross-cultural evaluations to furnish a more substantiated and practical comprehension of the interplay between customer engagement and artificial intelligence on environmentally conscious purchasing intentions. This would augment the study's relevance and applicability for both scholars and professionals.

5.3. Conclusions

Customer engagement, when directed by business toward sustainability, encourages consumers to adopt eco-friendly behaviors with rising environmental awareness that fosters broader societal responsibility. Our results indicate that AI-facilitated customer-engagement may foster green purchase intentions by developing positive attitudes. But customers' skepticism and/or perceived risk in different cultural settings is unsolved in this study, which can be tested empirically as a moderating factor by the future researchers. This is particularly relevant in online communities where shared values enhance engagement and advocacy for sustainable practices. This supports our second and third research questions (RQ2, RQ3) by showing that sustainability-oriented customer engagement can shape both green purchase intentions and positive attitudes toward eco-friendly products. With a growing understanding of greenwashing's negative impact, companies are encouraged to pursue authentic marketing efforts. By doing so, they help consumers become more discerning and reinforce societal trust in genuinely sustainable brands.

Understanding the influence of customer engagement on green purchase intentions confirms RQ2, indicating that targeted, transparent engagement strategies increase green purchase intentions among environmentally conscious consumers. Tailored, transparent campaigns that reduce skepticism and perceived risk can improve customer trust and encourage them for sustainable engagement. So, there is a great scope to integrate the risk theory and S-O-R (Stimulus $\rightarrow$ Organism $\rightarrow$ Response) theory. Marketing stimuli (Stimulus), like AI-augmented transparency and trust-building activities, can reduce customers' perceived risk (Organism) related to time, money, and security, arousing and building their purchase intention (Response) for products with green features. The above conceptualization complements the theme of 'risk theory', which posits that customer's psychological frameworks help them identify, analyze, and respond to uncertainty (social, financial, time, & performance) during their purchase decision-making for green products. This reflects the moderating role of perceived risk (RQ5), where affordability and accessibility can strengthen or weaken the engagement–intention link. This includes strategizing around pricing, availability, and product variety to make green products more appealing and accessible to a broader audience. Businesses can prioritize CSR initiatives aligning with consumer concerns, which can enhance customer engagement and loyalty, thereby driving purchase intentions and reinforcing the company's sustainable reputation.

The multifaceted relationship between AI enabled customer engagement, attitudes, and green purchase intentions is consistent with RQ4, reinforcing the mediating role of attitudes in translating customer engagement into purchase intentions, because AI-aided marketing, satisfaction, and trust for green products are the crucial constructs to arouse green intention [50]. Research on the role of cognitive factors, like perceived consumer effectiveness and behavioral control, in enhancing eco-friendly behaviors can add valuable insights. Comparative studies could investigate how consumer engagement and attitudes toward sustainability differ across cultural and geographic regions. Such research could extend RQ3 and RQ5 by examining how cultural context and risk perceptions shape sustainable purchase attitudes. Academics could study the economic psychology behind green purchases, exploring factors like price sensitivity, social influence, and behavioral reasoning. Such insights could contribute to more nuanced theories of eco-friendly consumer behavior and sustainable marketing.

Industries, especially those with significant environmental impact (e.g., fashion, food, electronics), are incentivized to embrace sustainability. Engaging consumers with transparent reporting on sustainable practices with innovation and value co-creation not only strengthens brand image but also mitigates the risk of reputational damage from greenwashing [51]. These implications substantiate RQ1. By incorporating consumer feedback

into product development, businesses can create green products that align with customer expectations, thereby enhancing purchase intentions. Industries can collaborate with policymakers to create favorable regulatory environments that support sustainable initiatives. This includes advocating for government incentives or subsidies that make sustainable production and green products more financially viable, encouraging broader adoption of eco-friendly practices across the market. In sum, by understanding and addressing these implications, businesses, policymakers, and academics can better support the transition to sustainable consumer practices, ultimately contributing to positive environmental, social, and economic outcomes.

This study highlights a growing consumer preference for eco-friendly products, with mildly positive sentiment and a balance of subjective and objective reviews. Customers appreciate sustainability, affordability, and effectiveness as key concerns, suggesting that brands need to focus on enhancing product quality, pricing strategies, and transparent sustainability claims. The bimodal sentiment distribution addresses RQ2 and RQ3 by evidencing how consumer engagement relates to attitudes and intentions, while also highlighting perceived risk factors (RQ5) such as cost and performance concerns. From a broader perspective, these insights have implications for industry, research, and practical applications. Businesses can leverage sentiment trends to refine marketing strategies, optimize product features, and improve packaging to align with customer expectations. For researchers, the mix of opinion-based and factual reviews provides valuable data for studying green consumer behavior and sustainable marketing. Additionally, policymakers can use these insights to promote eco-conscious purchasing decisions by addressing barriers like cost and performance concerns. Overall, the findings (Figure 5) suggest that while the green product market is expanding, continuous innovation, strategic communication, and affordability improvements are essential for wider adoption and long-term success.

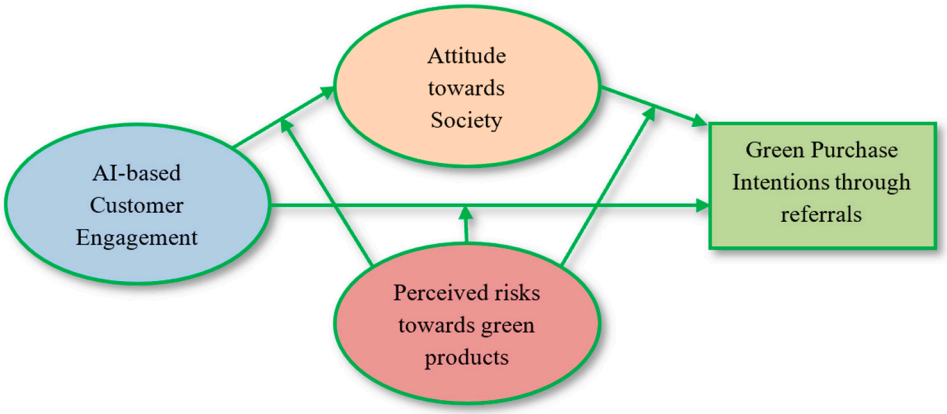

Figure 5. Conceptual Framework for future researchers.

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