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The Moderating Role of Artificial Intelligence Use in the Relationship between Environmental Attitude and Green Marketing

ABSTRACT

This study aims to investigate the moderating effect of artificial intelligence use on the relationship between environmental attitude and green marketing. This research adopts a quantitative correlational approach, employing structural equation modeling for analysis. A cross-sectional survey design was utilized to collect primary data from participants. Initially, 450 paper questionnaires were distributed, resulting in 400 completed responses, which reflects a participation rate of 89%. After discarding sixteen incomplete questionnaires, the final valid sample consisted of 384 responses. Data collection was conducted using standardized questionnaires, and the analysis involved Pearson correlation tests alongside structural equation modeling. The findings reveal that environmental attitudes significantly influence green marketing, evidenced by a T-value of 4.527. Furthermore, artificial intelligence use plays a crucial moderating role in the connection between environmental attitudes and green marketing, with a T-value of 6.957. The model fit analysis indicates that the research framework demonstrates a strong fit. The findings highlight the significant impact of artificial intelligence on business operations, ultimately offering actionable insights for implementing AI-enhanced green marketing strategies.

Keywords: Business, green marketing, AI, attitude, strategy

Introduction

Green marketing strategies have gained traction as firms recognize the dual benefits of environmental responsibility and competitive differentiation. Organizations are actively revising their value propositions and product development frameworks to appeal to environmentally conscious consumers, often using green certifications, eco-labels, and sustainability narratives as marketing levers [1]. Studies show that implementing green practices can improve financial outcomes by enhancing brand equity and customer loyalty [2, 3]. However, the effectiveness of these strategies is deeply influenced by consumer environmental attitudes—defined as individuals' cognitive, affective, and behavioral dispositions toward environmental protection [4]. In essence, green marketing cannot operate in a vacuum; it is driven by a two-way relationship wherein marketers both influence and are influenced by consumers' environmental orientations.

The significance of environmental attitudes in shaping sustainable consumption behavior has been corroborated in multiple contexts. Individuals with positive environmental attitudes are more likely to engage in pro-environmental actions, such as purchasing green products and supporting eco-conscious brands [5, 6]. These attitudes not only influence personal behavior but also reflect broader cultural and institutional values, especially in nations where environmental policies are embedded in public discourse. The rising importance of environmental considerations in consumer behavior has led firms to

reassess their marketing strategies to align with ethical and ecological standards. Notably, the Gallup Q12 survey confirms that consumer awareness and value-driven behaviors are becoming decisive factors in purchasing decisions [7]. Moreover, green marketing is now seen not merely as a branding tactic but as a holistic strategy involving sustainable sourcing, eco-design, and transparent communication [8, 9].

However, the relationship between environmental attitudes and actual green marketing behaviors is neither linear nor unidimensional. Mediating and moderating variables, including technological factors, significantly influence this relationship. One such factor is artificial intelligence, which has rapidly transformed marketing paradigms. AI enables real-time data collection, behavioral segmentation, and personalized content delivery—all of which are crucial for implementing efficient green marketing strategies [10, 11]. AI applications, ranging from predictive analytics to natural language processing and chatbot interactions, offer businesses a powerful tool to resonate with eco-conscious consumers on a more intimate and tailored level [6, 12].

Indeed, AI's capacity to enhance green marketing has been explored in several recent studies. For instance, Wang et al. (2024) highlight how AI-driven systems can amplify intrinsic employee motivation, thereby fostering organizational innovation—a key antecedent to successful green marketing [11]. Similarly, Pulkkinen et al. (2024) argue that participatory budgeting empowered by AI can enhance collaborative innovation in local governments, underscoring the scalability of AI-enhanced green practices across sectors [13]. From a managerial perspective, AI facilitates dynamic resource allocation and personalized engagement strategies, both of which are indispensable in environmentally driven campaigns [14, 15]. Furthermore, AI's integration with sustainable finance mechanisms enables better assessment of environmental, social, and governance (ESG) metrics, which directly affect firms' green marketing credibility and effectiveness [16, 17].

The inclusion of AI in sustainability-oriented strategies also aligns with broader shifts toward Total Quality Management (TQM) and performance-driven innovation models. Ahinful et al. (2024) emphasize that AI can support TQM by providing real-time feedback loops and monitoring systems, enhancing organizational responsiveness to environmental issues [18]. Similarly, Degenhart et al. (2022) demonstrate that psychological capital and managerial attitudes—both critical in navigating the complexities of green marketing—are significantly shaped by technological adoption and budgetary participation [19]. This intersection of managerial foresight and technological capability positions AI not just as a tool but as a strategic enabler in the green marketing ecosystem.

Moreover, budget participation and performance management systems are increasingly relying on AI to foster transparency and innovation. Studies have shown that enabling management control systems (MCS), when augmented with AI, positively influence innovation performance and budgeting efficiency [1, 20]. This technological augmentation is particularly relevant in contexts where traditional marketing methods fail to capture nuanced consumer expectations regarding sustainability. By leveraging AI, organizations can bridge the gap between stated environmental attitudes and observed green behaviors, thereby mitigating risks associated with greenwashing or ineffective campaigns [5, 21].

At the operational level, AI allows businesses to design responsive, data-driven marketing ecosystems that not only communicate sustainability messages effectively but also align with customer values and lifestyle preferences. For example, AI-powered platforms can track environmental trends, segment markets based on ecological consciousness, and adjust marketing content in real-time to reflect consumer sentiment [22, 23]. These capabilities are particularly valuable in emerging economies, where consumer awareness of environmental issues is growing but still unevenly distributed. As Koomson (2024)

observes, the psychological contract between organizations and employees also shapes the ethical climate in which green marketing initiatives are embedded, making AI an important moderator in aligning internal and external organizational dynamics [4].

Importantly, strategic thinking and innovation are crucial for the successful integration of AI into green marketing. AlQershi (2021) and Amir et al. (2021) argue that strategic planning, human capital development, and budgetary participation are interdependent factors that enhance organizational readiness for green transformation [2, 24]. AI, when embedded within such strategic frameworks, not only augments decision-making processes but also fosters a culture of continuous improvement and accountability [25]. It is in this context that the role of AI shifts from being a mere facilitator to a pivotal variable in shaping how environmental attitudes influence green marketing practices.

Furthermore, this study situates itself within a broader discussion of ethical marketing and institutional change. As Chigova and Hofisi (2023) contend, political and institutional systems must evolve to accommodate participatory, transparent, and innovation-friendly frameworks—conditions under which AI-driven green marketing can thrive [26]. The effective use of AI thus requires not only technological infrastructure but also supportive regulatory and organizational cultures that value sustainability and innovation.

In conclusion, the relationship between environmental attitude and green marketing is multifaceted, shaped by cognitive, affective, and behavioral variables that reflect broader socio-cultural and institutional contexts. The advent of AI introduces a transformative layer to this relationship, serving as a moderating force that can either amplify or diminish the effectiveness of green marketing initiatives. This study aims to empirically investigate the moderating role of AI use in the relationship between environmental attitudes and green marketing, thereby addressing an important research gap.

Methods and Materials

This research adopts a quantitative correlational approach, employing structural equation modeling to investigate the topic at hand. A cross-sectional survey design was utilized to collect primary data from participants, which proved effective for gathering information from a large sample within a short period. This method also provides a systematic framework for analyzing the constructs involved. The study's population includes all employees of Sabah Dairy Company in Gonbad Kavoud, Iran, with a statistical sample comprising 384 individuals selected through simple random sampling based on the Morgan table. Additionally, a convenience sampling technique was employed. Initially, 450 paper questionnaires were distributed, resulting in 400 completed responses, reflecting an 89% participation rate. After discarding 16 incomplete questionnaires, the final valid sample consisted of 384 responses. Participation was voluntary, and confidentiality for all respondents was assured.

Data collection was carried out through a structured questionnaire developed from a comprehensive review of relevant literature. This questionnaire was divided into two main sections. The first section aimed to collect demographic information about the participants, including variables such as gender, age, income, education level, and occupation. The second section focused on gathering data related to AI use, environmental attitudes, and green marketing practices. To assess the AI use, we employed six measurement constructs derived from the prior research (30). An example item included is, “AI helps our company to specifically design our products and services.” A 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), was adopted to measure all items. The Cronbach’s α coefficient for the entrepreneurial mindset was found

to be 0.96. To assess the environmental attitudes, we employed six items derived from the prior research (31). This measurement scale has been utilized by various scholars to gauge the environmental attitudes. An example of an item included is, “Protecting the environment is more important than protecting peoples’ jobs.” A 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), was adopted to measure all items. The reliability of the entrepreneurial intention scale, as indicated by Cronbach’s α, was found to be 0.92. To assess green marketing, we employed six measurement constructs derived from the prior research (32). This particular scale has been utilized by earlier scholars as well. An example item from the scale is, “Do you think companies should put more effort in green marketing?” A 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), was adopted to measure all items. The Cronbach’s α coefficient for the creativity construct was found to be 0.94.

Data analysis was conducted using SPSS-27 and Lisrel software. To characterize the variables, descriptive statistics, including means and standard deviations, were utilized. The Pearson correlation test was performed to evaluate the relationships among the variables. Additionally, the structural equation modeling approach was employed to explore the moderating role of AI use in the relationship between environmental attitudes and green marketing. A significance threshold of $P < 0.05$ was established.

Findings and Results

Descriptive statistics are presented in Table 1. The results reveal that, on the whole, the environmental attitude is above the average level. In contrast, both green marketing and AI use were assessed to be at a moderate level. The Kolmogorov-Smirnov tests confirmed that all variables adhered to a normal distribution (all $P>0.05$).

Table 1.

Descriptive data

	Environmental attitude	Green marketing	AI use
Mean	2.92	2.52	2.48
SD	0.45	0.33	0.25
Minimum	1	2	1
Maximum	5	5	5

Table 2 revealed that the Cronbach's alpha values for environmental attitude was 0.95, green marketing was 0.92, and AI use was 0.90. Additionally, the composite reliability for environmental attitude was 0.93, green marketing was 0.90, and AI use was 0.88. Finally, the average variance extracted (AVE) for environmental attitude was 0.641, for green marketing was 0.587, and for AI use was 0.553. These values exceed acceptable thresholds, indicating that the questionnaires utilized demonstrated satisfactory reliability and validity.

Table 2.

Validity and reliability

	Cronbach's alpha	Composite reliability	AVE
Environmental attitude	0.952	0.931	0.641
Green marketing	0.922	0.902	0.587
AI use	0.901	0.884	0.553

The relationships among environmental attitude, green marketing, and AI use are depicted in Table 3. The results reveal a substantial direct correlation between environmental attitude and green marketing ($P<0.001$). Furthermore, a direct and

significant relationship is observed between environmental attitude and AI use (P<0.001). Finally, AI use is also found to be directly and significantly associated with green marketing (P<0.001).

Table 3.

Results of bivariate relationships between variables

	1	2	3
1. Environmental attitude	-		
2. Green marketing	r=0.553	-	
	P<0.001		
3. AI use	r=0.634	r=0.471	-
	P<0.001	P<0.001	

Table 4 and Figure 1 present the findings from the structural equation modeling analysis. The results indicate that the environmental attitude has a significant impact on green marketing, with a T-value of 5.539. Additionally, the environmental attitude also significantly influences AI use, as evidenced by a T-value of 6.347. Furthermore, AI use plays a role in affecting green marketing, demonstrated by a T-value of 4.719. Notably, AI use serves as a significant moderator in the relationship between environmental attitude and green marketing, with a p-value of less than 0.001. The model fit results, detailed in Table 5, suggest that the research model exhibits a good fit.

Table 4.

Results of structural equation modelling

	Path	β	T-value
1	Environmental attitude => Green marketing	0.553	5.539
2	Environmental attitude => AI use	0.634	6.347
3	AI use => Green marketing	0.471	4.719
			P-value
4	Environmental attitude => AI use => Green marketing	0.653	P<0.001

Figure 1.

Structural equation modelling in the form of T-values

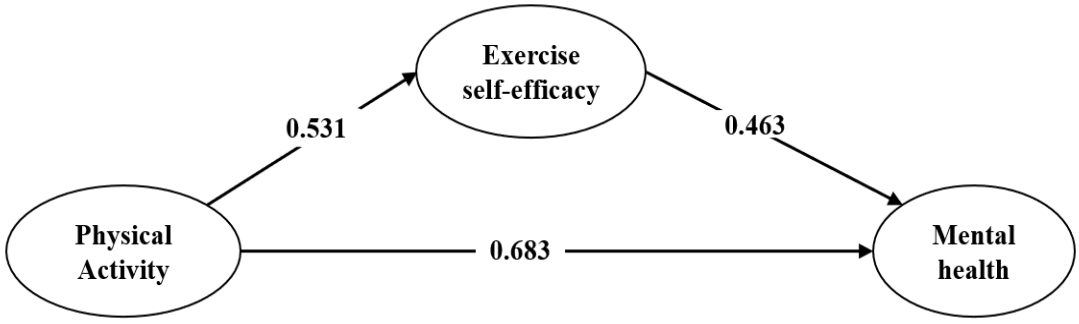

Table 5.

Results of model fit

Index	Optimal Range	Obtained Value	Conclusion
RMSEA	< 0.08	0.06	Good fit
X^2 / df	< 3	2.98	Good fit
RMR	Closer to 0	0.01	Good fit
NFI	> 0.9	0.98	Good fit
CFI	> 0.9	0.98	Good fit

Discussion and Conclusion

The findings of this study reveal that environmental attitudes have a significant and positive influence on green marketing, reinforcing the idea that individuals who hold strong pro-environmental beliefs are more likely to respond favorably to sustainability-oriented marketing strategies. This result is consistent with earlier research that emphasized the motivational role of environmental attitudes in shaping sustainable consumer behavior and fostering engagement with environmentally friendly products and services. It highlights the cognitive and affective dimensions of environmental concern as key psychological precursors of green marketing effectiveness. The data show a direct path from environmental attitudes to green marketing outcomes, suggesting that companies that target audiences with strong ecological values may benefit from heightened brand loyalty and customer trust [7, 8].

Moreover, the study identifies artificial intelligence use as a statistically significant moderator in the relationship between environmental attitude and green marketing. The interaction effect demonstrates that organizations leveraging AI technologies can better translate environmental attitudes into actionable and impactful green marketing strategies. This supports recent scholarship asserting that AI facilitates customer segmentation, behavior prediction, and campaign optimization in sustainability contexts [10, 11]. By employing AI to analyze large-scale consumer data and environmental behavior trends, businesses can align their marketing content with individual environmental values, leading to more effective engagement [14, 22]. In this way, AI not only enables precision in communication but also enhances personalization—two factors crucial for driving green behavioral intentions.

The significant relationship between AI use and green marketing observed in this study also validates the growing body of literature exploring the transformative role of digital technologies in green innovation [13, 16]. AI, when effectively utilized, enhances marketing efficiency and provides tools for measuring the environmental and social return on marketing investments. As organizations strive for transparency and authenticity in green claims, AI facilitates real-time monitoring of ESG (environmental, social, and governance) metrics and prevents “greenwashing” through data validation and integrity management [9, 17]. These capabilities align with stakeholder expectations in an era increasingly dominated by accountability and performance-driven sustainability.

Another important finding is the positive influence of environmental attitudes on AI use. This may appear indirect at first, but it suggests that environmentally conscious organizations and individuals are more likely to adopt AI tools in pursuit of sustainability goals. The result is aligned with prior research emphasizing the role of values and ethical orientation in technological adoption [6, 19]. Organizations whose leadership and employees possess strong environmental values are more inclined to leverage digital innovations to enhance their ecological footprint, contributing to the creation of a green organizational culture [15, 23]. From a psychological contract perspective, employees expect their organizations to reflect their environmental values, and AI becomes an instrument to fulfill this implicit agreement [4].

The study also draws attention to the relationship between AI use and improved green marketing outcomes. This finding reinforces the assumption that AI is not merely a technical enhancement but a strategic capability that transforms the nature and impact of marketing in the sustainability domain [3, 5]. The use of AI tools such as chatbots, recommendation engines, and predictive analytics has been shown to increase customer satisfaction and loyalty, particularly when these tools are aligned with eco-conscious messaging [20, 21]. This synergistic effect of AI and environmental marketing creates a positive feedback loop in which green branding is both enhanced and validated through intelligent technologies.

These findings also align with broader literature on strategic management and organizational innovation. As Ahinful et al. (2024) argue, innovation performance—especially in areas such as sustainable finance or environmental governance—requires a deliberate integration of quality management principles and digital tools [18]. AI supports this integration by offering data-backed insights that allow decision-makers to assess marketing effectiveness, measure environmental impact, and fine-tune strategies in real-time. Similarly, AlQershi (2021) identifies strategic thinking and human capital as mediators in the relationship between innovation and performance, suggesting that AI-enabled green marketing must be accompanied by organizational learning and skill development [24].

Furthermore, the study supports the role of participatory budgeting and inclusive decision-making in achieving sustainable marketing outcomes. Pulkkinen et al. (2024) highlight that AI-powered participatory tools can promote innovation in public administration and service delivery, thereby extending the relevance of AI-enhanced green marketing beyond the private sector into policy and governance frameworks [13]. This aligns with Tsofa et al. (2023), who emphasize that sub-national planning and budgeting require technological supports to navigate political complexities in sustainability efforts [12]. In both public and private contexts, AI thus serves as a mediator between organizational values and environmental outcomes.

The integration of these findings indicates that the success of green marketing initiatives depends not only on consumer-side environmental awareness but also on firm-level adoption of AI-driven strategies that amplify environmental values. As demonstrated in prior studies, such integration fosters innovation and operational efficiency [1, 27]. However, the mere adoption of AI is not sufficient unless it is guided by environmentally grounded organizational values and stakeholder engagement. This synergy between values, technology, and marketing strategy forms the conceptual basis for the model tested in this study.

Collectively, this research contributes to the theoretical understanding of how AI moderates the effect of environmental attitudes on green marketing. It offers empirical support for multidimensional frameworks that account for psychological, technological, and strategic variables in explaining green marketing effectiveness. Moreover, it answers the call by recent scholars to expand sustainability research beyond descriptive metrics to include interactive models that capture the complexity of digital-era consumer behavior [26, 28]. By integrating AI as a moderating construct, the study bridges marketing science, environmental psychology, and innovation management.

Despite its contributions, the present study has several limitations that should be acknowledged. First, the cross-sectional nature of the research restricts causal inferences. While structural equation modeling can reveal statistically significant relationships, it cannot establish temporality or directionality with full confidence. Longitudinal research designs would offer more robust insights into how environmental attitudes evolve over time and how AI implementation matures in green marketing contexts. Second, the study was conducted within a single industry context and a limited geographic scope, potentially constraining the generalizability of findings. Cultural, institutional, and regulatory differences may influence both environmental attitudes and the adoption of AI technologies in different sectors or countries. Third, although the study relies on validated measurement instruments, the self-report nature of the data collection process might be subject to common method bias or social desirability effects, particularly in questions regarding environmental concern and sustainability behaviors.

Future studies could explore the longitudinal dynamics of AI integration in green marketing to assess how this relationship unfolds over time, especially in response to environmental crises or regulatory changes. Expanding the research to include

cross-national comparisons would also be valuable for understanding how regional policies, digital infrastructure, and consumer expectations influence the effectiveness of AI-enhanced green marketing strategies. Additionally, future research could examine mediating variables such as employee innovation behavior, corporate environmental culture, or organizational agility in the relationship between environmental attitudes and green marketing. It would also be useful to incorporate objective performance metrics such as energy savings, carbon reduction, or ESG scores to triangulate self-reported measures of environmental engagement and marketing effectiveness.

Organizations aiming to implement green marketing strategies should consider environmental attitudes as a critical entry point for designing effective campaigns. However, these attitudes need to be operationalized through advanced AI tools that can personalize communication and analyze consumer behavior in real-time. Investment in AI infrastructure should be paired with training programs to enhance employee digital literacy and ecological awareness. Additionally, companies should ensure that their use of AI aligns with ethical guidelines and transparency standards, avoiding potential pitfalls like greenwashing or data misuse. Firms should also adopt integrated sustainability frameworks that combine environmental performance with digital innovation, reinforcing their commitment to both planet and profit. Finally, partnerships with AI vendors, NGOs, and research institutions can offer valuable support in scaling and optimizing green marketing initiatives across industries.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. Written consent was obtained from all participants in the study.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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