

Perceived Sustainability in Metaverse: How Immersive Features and Value Perceptions Shape Eco-Conscious Consumer Responses

Mina Park · Eunjung Shin[†]

Graduate Student, Fashion Information, Graduate School of Human Environmental Sciences, Yonsei University, South Korea

Assistant Professor, Division of Global Fashion Industry, Hansung University, South Korea

Abstract This study investigates how platform characteristics and consumption values influence consumer attitudes and purchase intentions toward metaverse-based sustainable fashion products. It further examines whether these relationships differ according to consumers' levels of environmental awareness. Two key characteristics—presence and interactivity—were identified as significant drivers of positive consumer responses. Among consumption values, social, epistemic, and conditional values enhanced both attitude and purchase intention, while Emotional value showed a significant negative effect on purchase intention, suggesting that emotionally driven engagement in immersive environments may not necessarily translate into sustainable purchasing intentions. Attitude was also positively linked to purchase intention for metaverse-based sustainable fashion products. Consumers with higher environmental awareness perceived greater interactivity and higher value across multiple dimensions than those with lower awareness. These findings underscore the importance of integrating immersive design elements and value-based sustainability communication in metaverse. By highlighting how environmental consciousness amplifies engagement, this study provides theoretical insights and strategic directions for advancing sustainable consumer experiences in digital fashion environments.

Keywords Metaverse, Consumption value, Sustainable fashion, Attitude, Purchase intention, Environmental awareness

Citation Park, M. N., & Shin, E. J. (2026). Perceived sustainability in metaverse: How immersive features and value perceptions shape eco-conscious consumer responses. *International Journal of Costume and Fashion*, 26(1), 17-32

Introduction

The rapid expansion of digital environments and the growing demand for immersive experiences have accelerated the rise of metaverse as a new frontier in fashion consumption. Consumers increasingly seek interactive spaces that allow personalized self-expression, and brands are responding by creating avatar-based environments where users can engage with fashion products in creative and social ways. These platforms represent evolving socio-technical spaces that reshape consumer-brand interaction and the fashion experience (Park & Lim, 2023).

Within this context, fashion brands are introducing metaverse-based fashion products that enable consumers to express individuality through digital identities. As sustainability has become a central value in the fashion industry, many brands are integrating environmental principles into their digital offerings. Virtual sustainable fashion products—digital garments and experiences reflecting eco-conscious values—present not only new aesthetic and social opportunities but also potential environmental benefits, such as reduced resource consumption and minimized waste

Received October 9, 2025; Revised February 13, 2026; Accepted March 13, 2026

[†] Corresponding Author: ejshin@hansung.kr

(Periyasamy & Periyasami, 2023). This alignment between digital innovation and sustainability reflects findings by Rausch et al (2021), who noted that sustainability claims meaningfully shape consumer perception and behavioral intention in retail contexts.

Despite this development, empirical research on sustainability within metaverse remains scarce. Previous studies have examined consumer engagement or aesthetic experience in virtual fashion spaces (Kim et al., 2025; Luong et al., 2024), yet few have addressed how immersive platform characteristics influence sustainability-driven attitudes and behaviors. As digital fashion evolves from an experimental showcase to a central component of brand strategy (Chan et al., 2024; Hu et al., 2025; Profumo et al., 2024), understanding how consumers interpret sustainability cues in these environments becomes increasingly important.

Therefore, this study investigates sustainable virtual fashion as an emerging domain of consumer behavior within metaverse. Specifically, this study examines how immersive platform characteristics (presence and interactivity) and multidimensional consumption values shape consumers' attitudes and purchase intentions toward virtual fashion products, with perceived sustainability conceptualized as a perceptual interpretive frame through which these immersive experiences are evaluated. Furthermore, it explores how consumption values (e.g., emotional, functional, social) shape these relationships and how they differ according to consumers' levels of environmental awareness. By empirically validating these mechanisms, this research extends the literature on digital fashion consumption and sustainability communication, offering both theoretical and managerial insights into how immersive digital experiences can foster ethical and environmentally conscious fashion engagement. In this study, metaverse-based fashion platforms refer to fashion-centered immersive environments within the metaverse (e.g., Zepeto, Roblox fashion experiences). For clarity, we hereafter use the term metaverse to denote this fashion-specific scope.

Theoretically, this study extends metaverse and sustainable fashion literature by conceptualizing sustainable virtual fashion as perceived sustainability and empirically validating the joint effects of immersive platform characteristics and

multidimensional consumption values. From a managerial perspective, the findings provide actionable insights for digital fashion platforms and brands by demonstrating how immersive design elements and value-based sustainability communication shape consumer attitudes and purchase intentions. From an educational perspective, this study contributes to sustainability communication and digital fashion literacy by illustrating how immersive environments can enhance consumers' understanding of ethical and environmental values in fashion.

Literature review

Metaverse and Immersive Consumption

In this study, the term metaverse refers specifically to fashion-centered immersive environments within the broader metaverse ecosystem, characterized by avatar-based interaction, customization, and digital commerce (e.g., Zepeto, Roblox). This definition situates the metaverse as a focused subset of the metaverse, emphasizing fashion engagement and commerce. Defined as interactive and persistent 3D spaces, metaverse provides opportunities for economic, social, and cultural participation. These environments—represented by platforms such as Zepeto Roblox and similar avatar-based spaces—allow consumers to explore fashion experiences that merge creativity and community.

Building on prior research (Profumo et al., 2024; Blázquez, 2024), metaverse are conceptualized as socio-technical systems that integrate sensory immersion (presence) and participatory engagement (interactivity). These immersive affordances foster meaningful consumer-brand interaction and are increasingly applied to retail innovation and digital merchandising. Empirical findings (Xin et al., 2025) further confirm that such features enhance user engagement and influence sustainability-related perceptions in virtual fashion contexts.

Sustainability and Value Perception in Virtual Fashion

As environmental concerns intensify, sustainability has

become a key principle in fashion consumption and communication. Metaverse-based fashion products—digital garments or experiences designed with eco-conscious values—offer new ways for consumers to participate in sustainability without the physical production and waste associated with traditional retail. Virtual shows and campaigns, such as Gucci's *Off the Grid* in *The Sims*, illustrate how brands convey sustainability through digital creativity rather than material production.

From a consumer perspective, value perception remains central to sustainable behavior. According to Sheth et al. (1991), consumption values include functional, emotional, social, epistemic, and conditional dimensions. In virtual fashion contexts, these values manifest differently: curiosity and novelty drive epistemic value, social image and identity foster social value, and conditional relevance emerges through platform-based experiences and collaborations (Kumar et al., 2025). Previous studies (Bazi & Hajawi, 2025; Kim et al., 2025) highlight emotional engagement but often overlook how sustainability and multidimensional values interact within immersive platforms. This study addresses that gap by integrating consumption value theory with sustainability awareness to explain consumer responses to metaverse-based fashion products. In this study, the concept of sustainable virtual fashion is approached as perceived sustainability, referring to consumers' recognition of ecological, ethical, and symbolic environmental values communicated through digital fashion design, narratives, and platform experiences. In the present study, sustainability was not treated as an objectively verified environmental performance indicator, but as a perception-based cognitive construct elicited through descriptive explanations and visual examples of eco-themed virtual fashion concepts provided during the survey. Accordingly, sustainable virtual fashion products refer to digitally embodied fashion items or experiences that convey environmental or ethical values without requiring physical production, such as eco-themed digital garments, virtual-only fashion collections, or avatar-based fashion items associated with sustainability narratives.

This perspective differentiates perceived sustainability—a psychological and cognitive construct—from actual sustainability, which involves measurable environmental

performance such as resource efficiency or carbon reduction. Accordingly, the stimuli presented to participants represented fashion concepts with ecological themes, not empirically verifiable sustainable products. This definition provides conceptual clarity by distinguishing cognitive perception of eco-ethical meaning from tangible environmental performance, thus aligning the study's constructs with the attitudinal and behavioral variables measured in subsequent analyses.

Presence is defined as the extent to which users feel psychologically immersed in the virtual environment (Tseng et al., 2022), whereas interactivity refers to real-time reciprocal engagement between users and system agents (Go et al., 2021). Consumption values comprise functional, emotional, social, epistemic, and conditional dimensions (Sheth et al., 1991), reflecting consumers' evaluations of usefulness, affect, social meaning, curiosity, and situational relevance within metaverse experiences.

In this study, sustainable virtual fashion is operationalized as perceived sustainability, reflecting consumers' recognition of ecological and symbolic environmental values embedded in digital fashion experiences. To ensure conceptual consistency, participants were provided with a standardized explanation and visual examples prior to evaluation.

In virtual fashion contexts, consumption values are activated through distinct experiential cues. Functional value is evoked by perceptions of practical utility, price appropriateness, usability, and performance efficiency of metaverse-based fashion products, even in their digital-only form. Emotional value arises from hedonic enjoyment, aesthetic appeal, immersive pleasure, and emotional attachment fostered through avatar embodiment and interactive experiences. Social value is shaped by social image, identity expression, and peer recognition within virtual communities, while epistemic value is driven by curiosity, novelty, and the exploratory nature of immersive environments. Finally, conditional value emerges from situational relevance, such as platform-specific events, collaborations, and limited-time virtual experiences. These value perceptions function as psychological mechanisms through which sustainability narratives embedded in virtual fashion environments are

cognitively and emotionally internalized by consumers.

Consumer Awareness, Attitude, and Purchase Intention

Environmental awareness represents consumers' cognitive and affective connection to sustainability (McBride et al., 2013; Fu et al., 2020). Individuals with higher awareness tend to evaluate eco-friendly cues more favorably and translate these perceptions into positive attitudes and behavioral intentions. Within metaverse, sustainability cues embedded in design, storytelling, and brand interactions can activate these responses.

Within immersive environments, consumers' perceptions of novelty and aesthetic quality correspond to emotional and epistemic values, while ethical resonance aligns with social and conditional values that reflect moral expression and contextual relevance. Presence and interactivity serve as psychological channels through which these value perceptions translate into attitude and purchase intention, forming an integrated theoretical path consistent with Sheth et al.'s (1991) consumption value model.

Based on the preceding theoretical discussion, this study proposes the following research questions:

- RQ1.** How are the characteristic dimensions of immersive virtual platforms conceptualized and identified?
- RQ2.** How do the platform characteristics influence consumers' attitudes and purchase intentions toward sustainable fashion products within immersive virtual platforms?
- RQ3.** How do consumption values affect consumers' attitudes and purchase intentions toward these sustainable fashion products?
- RQ4.** How does consumer attitude influence purchase intention for sustainable fashion products in immersive virtual platforms?
- RQ5.** Are there significant differences in platform characteristics, consumption values, attitudes, and purchase intentions based on consumers' levels of environmental awareness?

Methodology

Grounded in the purpose of examining perceived sustainability within metaverse-based fashion environments, this study investigates how immersive platform characteristics (presence and interactivity) and multidimensional consumption values influence consumer attitudes and purchase intentions toward perceived metaverse-based sustainable fashion products.

In addition, this study examines whether these relationships differ according to consumers' levels of environmental awareness, reflecting variations in eco-conscious interpretations of immersive fashion experiences.

Respondents were recruited based on prior experience with metaverse or virtual platforms that allow avatar-based interaction. Zepeto and Roblox were presented as representative examples of metaverse-based fashion platforms, accompanied by screenshots to provide a common reference frame for respondents. Respondents were instructed to base their answers on the platform in which they had experienced avatar customization or virtual item consumption related to appearance or self-presentation.

Prior to the main survey, a pilot study was conducted with 20 respondents who had prior experience with metaverse or virtual platforms. The pilot study was used to assess item clarity, contextual relevance, and preliminary reliability. Based on participant feedback, minor wording revisions were made and redundant items were removed. All constructs demonstrated acceptable internal consistency, with Cronbach's alpha values exceeding 0.70. This instruction was intended to anchor responses to fashion-related virtual experiences rather than gameplay-oriented interactions.

Measurement items

To operationalize the study constructs, all survey items were adapted from established measurement scales in prior research and modified to fit the metaverse-based fashion context. Prior to completing the survey, participants were provided with a brief written explanation of sustainable virtual fashion products. This explanation emphasized that sustainability in the metaverse context refers to reduced physical production, digital-only consumption, and symbolic

environmental responsibility, rather than objectively measured lifecycle performance. Participants were instructed to respond based on this shared framing when evaluating sustainability-related items. This explanation defined such products as virtual-only fashion items or experiences that embody sustainability values without physical production. To facilitate understanding, visual examples and screenshots illustrating sustainability-themed virtual fashion concepts within immersive platforms were also presented. Participants were instructed to respond to all survey items based on this explanation and the provided examples.

The final questionnaire included a total of 66 items. Specifically, the experience of using immersive virtual platforms was measured using a five-item scale derived from Boo (2023). Platform characteristics were assessed with 15 items adapted from Ball (2022), Jang et al. (2019), and Tan (2018). Consumption values were measured with 20 items based on Sheth et al. (1991). Consumer awareness of environmental issues was initially measured using eight items adapted from Karp (1996), Minton et al. (1997), and Ahn et al. (2021). However, one item was removed during exploratory factor analysis due to a factor loading below .50. The final environmental awareness construct therefore consisted of seven items. Attitude toward sustainable fashion products was measured with 6 items based on Fishbein and Ajzen (1974) and Foroudi (2019). Purchase intention was assessed using 5 items from Putrevu and Lord (1994) and Salisbury et al. (2001). Demographic characteristics were captured through 7 additional items. While experience and demographic questions were measured using nominal scales, all other items were measured on a 5-point Likert scale (1 = Strongly disagree, 5 = Strongly agree). Scale items were reviewed by two fashion marketing scholars to ensure contextual relevance to metaverse settings.

Prior to the questionnaire, participants were provided with a brief description and screenshots illustrating examples of metaverse (e.g., Zepeto, Roblox). They were instructed to select the platform they were most familiar with when responding to all subsequent questions, ensuring consistent cognitive framing across participants and enhancing measurement validity for platform-related constructs.

Sampling and data collection

The data were collected through Embrain, a professional online research firm in South Korea, which maintains a nationally representative consumer panel. Participants—men and women in their 20s and 30s who had prior experience with immersive virtual platforms—were invited via email and rewarded with a nominal monetary incentive for their participation. Out of 300 distributed questionnaires, 271 valid responses were retained after excluding incomplete or invalid cases. Statistical analyses were conducted using SPSS 29.0, including frequency analysis, exploratory factor analysis, reliability testing (Cronbach's α), multiple regression, and independent-samples t-tests.

Among the 271 respondents, 131 (48.3%) were male and 140 (51.7%) were female. A majority, 147 (54.2%), were aged between 20–29, while 124 (45.8%) were between 30–39. In terms of residence, 172 participants (63.5%) lived in the Seoul metropolitan area, and 99 (36.5%) resided elsewhere. Regarding marital status, 221 (81.5%) were single and 49 (18.1%) were married. Most respondents held at least a university degree (60.1%), and the most common occupation was general office work (44.3%). Monthly income distribution indicated that 99 participants (36.5%) earned less than 2 million KRW.

In terms of platform usage, most participants reported using immersive virtual platforms once or twice a month ($n = 180$, 66.4%), while daily usage of 10–30 minutes was reported by 74 respondents (27.3%). The primary motivations for platform usage were “because it is interesting” ($n = 100$, 36.8%) and “to try new technologies” ($n = 87$, 32.1%). These findings suggest that digitally literate young consumers exhibit exploratory engagement patterns with immersive platforms, making them an appropriate segment for examining emerging sustainable virtual fashion consumption.

The framework illustrates the relationships among immersive platform characteristics (presence, interactivity), consumption values (functional, emotional, social, epistemic, conditional), and consumer responses (attitude, purchase intention). Differences based on environmental awareness are examined through group comparisons within the perceived sustainability context, highlighting variations in eco-conscious interpretations.

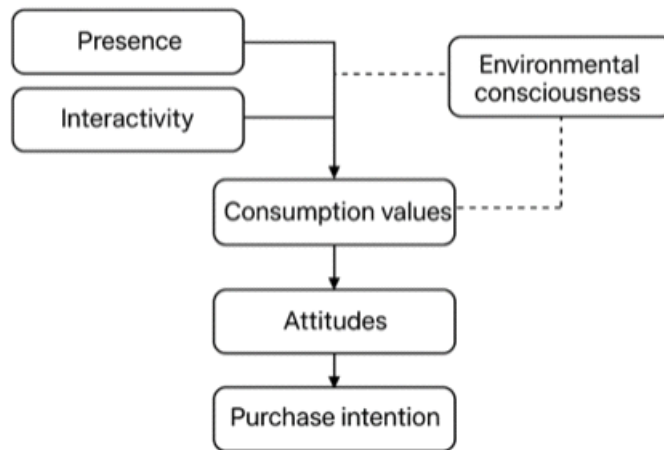


Figure 1. Conceptual Framework of the Study

Results

Measurement validity and reliability

Exploratory factor analysis verified the validity and reliability of all constructs. The KMO value exceeded .80, and Bartlett's

test of sphericity was significant ($p < .001$), confirming the suitability of the data for factor analysis. Two dimensions—presence and interactivity—were extracted for metaverse characteristics, explaining 60.37% of the total variance. Both factors showed high internal consistency ($\alpha = .870$ and $.824$).

Table 1. The results of metaverse characteristics factor and reliability analysis

Construct	Items	Factor loading	Eigen value	Variance (%)	Accumulated variance (%)	Cronbach's α
Presence	I feel like the virtual world and reality are connected on the metaverse.	.682	3.651	33.195	33.195	.870
	Your experience on the metaverse is connected to your experience in the real world.	.718				
	I think I'll be able to touch avatars and things on the metaverse.	.813				
	I feel like the virtual reality world of the metaverse exists.	.860				
	I feel like I (the avatar) is real on the metaverse.	.812				
Interactivity	I can engage with users on topics of common interest through the metaverse.	.712	2.989	27.177	60.372	.824
	Users will recognize and appreciate your value on the metaverse.	.635				
	I feel a kinship with other users on the metaverse.	.610				
	I can create content and engage with others on the metaverse.	.752				
	I can create and share the content I want on the metaverse.	.719				
	I may trade goods or services according to the currency or transaction method accepted within the metaverse.	.624				

Table 2. The results of consumption value factor and reliability analyses

Construct	Items	Factor loading	Eigen value	Variance (%)	Accumulated variance (%)	Cronbach's α
Functional value	I care about the practicality of the metaverse-based fashion product.	.679	2.579	14.326	44.606	.788
	I care about the quality of the metaverse-based fashion product quality.	.780				
	I care about the reliability and durability of my metaverse-based fashion products.	.830				
	I care that the metaverse-based fashion product is appropriate price.	.585				
Emotional value	I value buying metaverse-based fashion products that bring me pleasure.	.816	1.923	10.682	55.288	.756
	I care about the happiness you get from your metaverse-based fashion product.	.763				
Social value	When I buy a metaverse-based fashion product, I care about the reactions of those around me.	.807	2.830	15.720	15.720	.839
	When I choose a metaverse-based fashion product, I consider whether it will make me feel special.	.770				
	When I choose a metaverse-based fashion product, I want it to be in line with my status and dignity.	.719				
	When I choose a metaverse-based fashion product, I consider whether it will be noticed by others.	.736				
Epistemic value	I choose a metaverse-based fashion product that sparks my curiosity.	.669	2.621	14.560	30.280	.793
	I choose a new style of metaverse-based fashion product.	.758				
Conditional Value	I buy name-brand products even if they are expensive.	.534	1.870	10.390	65.679	.616
	I buy products I've heard about in the media.	.758				
	I buy products recommended by others.	.703				
	I buy products that are easy to access.	.566				

Table 3. The results of awareness toward environmental issues factor and reliability analysis

Construct	Items	Factor loading	Eigen value	Variance (%)	Accumulated variance (%)	Cronbach's α
Knowledge	I am aware of the environmental problems caused by waste disposal.	.817	2.824	40.348	40.348	.857
	I am aware of the environmental issue of poor air quality due to fine particulate matter.	.866				
	I am aware of the environmental problems caused by the increase in trash.	.837				
	I am aware of the environmental issues of chemicals in my life (detergents, humidifier sanitizers, air fresheners).	.811				
Attitude	I generally think about the amount of garbage I create before I buy things.	.818	1.910	27.283	67.631	.709
	When I buy things, I buy things that can be recycled, even if they cost a little more.	.819				
	I refrain from using disposables such as paper cups and wooden chopsticks.	.738				

Consumption values were grouped into five factors—functional, emotional, social, epistemic, and conditional—with Cronbach's α ranging from .616 to .839, indicating acceptable reliability. For environmental awareness, two dimensions—knowledge and attitude—were identified, with reliability coefficients of .857 and .709. Attitude and purchase intention toward metaverse-based sustainable fashion products also demonstrated excellent reliability ($\alpha = .927$ and .919, respectively).

One environmental awareness item was excluded during exploratory factor analysis due to low factor loading ($< .50$).

and interactivity ($\beta = .174, p < .01$) significantly influenced consumer attitudes. Similarly, presence ($\beta = .468, p < .001$) and interactivity ($\beta = .137, p < .05$) had positive effects on purchase intentions, as shown in Table 6, which summarizes the impact of metaverse characteristics on consumers' attitudes and purchase intentions toward metaverse-based sustainable fashion products.

Effects of consumption values

Regression results indicated that social ($\beta = .152, p < .05$), epistemic ($\beta = .271, p < .001$), and conditional ($\beta = .203, p < .05$) values positively influenced consumer attitudes, whereas

Table 4. The results of consumers' attitude reliability analysis

Construct	Items	Cronbach's α
Consumers' product attitudes	I have good favor with metaverse-based sustainable fashion products.	.927
	I trust metaverse-based sustainable fashion products.	
	I like the metaverse-based sustainable fashion products.	
	I want a metaverse-based sustainable fashion products.	
	I'm interested in metaverse-based sustainable fashion products.	
	I think the metaverse-based sustainable fashion products are fascinating.	

Table 5. The results of purchase intention reliability analysis

Construct	Items	Cronbach's α
Purchase intention	I've become more interested in buying metaverse-based sustainable fashion products.	.919
	I am more likely to buy metaverse-based sustainable fashion products.	
	I want to buy metaverse-based sustainable fashion products.	
	I am willing to speak positively about buying metaverse-based sustainable fashion products.	
	I will recommend metaverse-based sustainable fashion products to others.	

Effects of metaverse characteristics

Multiple regression analysis was conducted to examine the effects of presence and interactivity on consumer attitudes and purchase intentions. Both presence ($\beta = .421, p < .001$)

.01) values positively influenced consumer attitudes, whereas functional and emotional values had no significant effects. Regarding purchase intentions, emotional value showed a slightly negative effect ($\beta = -.125, p < .05$), while social ($\beta =$

Table 6. Effects of metaverse characteristics on customers' attitude and purchase intentions toward metaverse-based sustainable fashion products

Dependent variable	Independent variable	<i>B</i>	β	<i>t</i>	<i>p</i>	Multicollinearity	
						Tolerance	VIF
Consumers' product attitude	Presence	.570	.421	6.734***	<.001	.679	1.473
	Interactivity	.224	.174	2.781**	.006	.679	1.473
$R^2 = .290$, adj. $R^2 = .285$, $F=54.727^{***}$							
Purchase intention	Presence	.547	.468	7.594***	<.001	.679	1.473
	Interactivity	.152	.137	2.218*	.027	.679	1.473
$R^2 = .310$, adj. $R^2 = .305$, $F=60.162^{***}$							

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 7. Consumption value affects consumers' attitudes and purchase intentions of metaverse-based sustainable fashion products

Dependent variable	Independent variable	<i>B</i>	β	<i>t</i>	<i>p</i>	Multicollinearity	
						Tolerance	VIF
Consumers' product attitude	Functional value	-.119	-.051	-.831	.407	.761	1.314
	Emotional value	-.522	-.123	-1.953	.052	.714	1.401
	Social value	.250	.152	2.209*	.028	.598	1.674
	Epistemic value	.467	.271	4.175***	<.001	.675	1.483
	Conditional value	.419	.203	3.195**	.002	.706	1.416
$R^2 = .246$, adj. $R^2 = .232$, $F=17.305^{***}$							
Purchase intention	Functional value	-.168	-.083	-1.363	.174	.761	1.314
	Emotional value	-.458	-.125	-2.002*	.046	.714	1.401
	Social value	.278	.196	2.868**	.004	.598	1.674
	Epistemic value	.376	.253	3.921***	<.001	.675	1.483
	Conditional value	.318	.178	2.827**	.005	.706	1.416
$R^2 = .258$, adj. $R^2 = .244$, $F=18.440^{***}$							

* $p < .05$ ** $p < .01$ *** $p < .001$

.196, $p < .01$), epistemic ($\beta = .253$, $p < .001$), and conditional ($\beta = .178$, $p < .01$) values had significant positive effects, as summarized in Table 7, which presents the impact of consumption values on consumers' attitudes and purchase

intentions toward metaverse-based sustainable fashion products. This result suggests that in virtual contexts, symbolic and experiential cues outweigh traditional utilitarian assessments.

Impact of consumer attitudes on purchase intention

A strong positive relationship was found between consumer attitude and purchase intention ($\beta = .857$, $p < .001$), explaining 73.5% of the variance in purchase intention, as shown in Table 8, which presents the effect of consumers' attitudes on purchase intentions toward metaverse-based sustainable fashion products.

tion values, consumer attitudes, and purchase intentions between consumers with high and low awareness of environmental issues. The results were presented in Table 9, which summarizes the differences in metaverse characteristics, consumption values, consumer attitudes, and purchase intentions across environmental awareness groups.

Among the metaverse characteristics, interactivity

Table 8. Consumers' attitudes affect purchase intentions of metaverse-based sustainable fashion products

Dependent variable	Independent variable	<i>B</i>	β	<i>t</i>	<i>p</i>
Purchase intention	Consumer's product attitude	.740	.857	27.299***	<.001
$R^2 = .735$, adj. $R^2 = .734$, $F = 745.210^{***}$					

* $p < .05$ ** $p < .01$ *** $p < .001$

Group differences by environmental awareness

To address research question 5, an independent samples t-test was conducted to examine whether there were statistically significant differences in metaverse characteristics, consump-

tion values, consumer attitudes, and purchase intentions between the two groups ($t = -2.861$, $p < .01$), indicating that consumers with higher environmental awareness perceived greater interactivity on immersive virtual platforms. In terms of consumption values,

Table 9. Differences in metaverse characteristics, consumption values, consumers' product attitudes, and purchase intentions across awareness toward environmental issues groups

Construct		Group with low environmental awareness (N=126)		Group with high environmental awareness (N=145)		<i>t</i>	<i>p</i>
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Metaverse characteristics	Presence	11.0333	3.09691	10.9766	3.68122	.136	.892
	Interactivity	15.4590	3.12251	16.6770	3.87971	-2.861**	.005
Consumption value	Functional value	12.6607	2.02298	14.1983	1.61345	-6.955***	<.001
	Emotional value	5.7976	1.18858	6.1897	.97016	-2.946**	.004
	Social value	9.5020	2.47073	9.8310	3.08486	-.974	.331
	Epistemic value	10.0159	2.38720	11.0276	2.84634	-3.182**	.002
	Conditional value	10.0615	2.09730	10.3345	2.35061	-1.002	.317
Consumers' product attitude		14.1653	4.19182	15.5046	4.90063	-2.398*	.017
Purchase intention		11.4032	3.52844	12.0097	4.34910	-1.267	.206

* $p < .05$ ** $p < .01$ *** $p < .001$

Note. SD = Standard deviation, M=Mean.

significant differences were found in functional value ($t = -6.955, p < .001$), emotional value ($t = -2.946, p < .01$), and epistemic value ($t = -3.182, p < .01$), with the high-awareness group reporting higher scores than the low-awareness group. No significant differences were observed for presence, social value, or conditional value.

Regarding consumer responses, attitude toward metaverse-based sustainable fashion products showed a significant difference ($t = -2.398, p < .05$), with the high-awareness group demonstrating more favorable attitudes. However, purchase intention did not show a statistically significant difference between the two groups ($t = -1.267, p > .05$).

These results suggest that consumers with higher environmental awareness were more engaged with interactive features of the platform and place greater importance on functional, emotional, and epistemic aspects of value. They also tend to hold more positive attitudes toward metaverse-based sustainable fashion products, although this does not necessarily translate into significantly higher purchase intentions. These findings complement previous research emphasizing the sensory and experiential determinants of metaverse shopping experiences (Kim et al., 2025; Hu et al., 2025), but extend them by validating the significance of sustainability-driven values and environmental consciousness.

Discussion and Conclusions

In this study, sustainability does not function as an independent construct within the structural model but rather as a contextual framing condition under which immersive platform experiences and consumption values are evaluated. Thus, the contribution of this research lies in examining how established digital engagement mechanisms operate when sustainability serves as the evaluative lens for virtual fashion consumption.

Consistent with recent research (Kim et al., 2025), this study empirically substantiates the growing relevance of immersive experiences and user interactivity in digital fashion consumption. Extending prior conceptual discussions, it extends the literature by validating the moderating role of environmental awareness, thereby integrating sustainability

consciousness into the theoretical framework of metaverse consumer behavior. This integration bridges two previously distinct research domains—immersive technology and sustainable fashion—offering an empirically grounded model of how digital affordances interact with psychological and value-based mechanisms to shape consumer engagement in virtual environments.

The results diverge from prior studies emphasizing visual quality (Kim et al., 2025) or inspirational experience (Bazi & Hajawi, 2025), which primarily addressed aesthetic or affective dimensions. Rather than functioning as an independent behavioral driver, sustainability in this study operates as a symbolic and cognitive meaning-making layer that shapes how immersive metaverse fashion experiences are interpreted and evaluated by consumers. This suggests that immersive environments can serve as ethical as well as experiential spaces, transforming sustainability from a peripheral message into an active behavioral driver. Furthermore, unlike Jia and Mvondo (2025), who reported negative psychological outcomes associated with virtual immersion, this study highlights the potential of immersive environments to foster pro-environmental attitudes and purchase intentions when designed around sustainable value frameworks.

While the findings indicate that immersive affordances can foster pro-environmental attitudes and strengthen behavioral intentions, causal inference remains limited due to the cross-sectional design. From a managerial perspective, these findings complement Hu et al. (2025) by extending strategic implications from brand-level design to consumer-level behavioral engagement, providing actionable insights for firms developing sustainable virtual fashion offerings.

This study provides timely insights into how consumers perceive and engage with metaverse-based sustainable fashion products within immersive digital environments. As immersive commerce continues to evolve in the post-pandemic era, understanding how platform characteristics and multidimensional consumption values shape user behavior becomes increasingly critical for both theory and practice.

First, factor analysis revealed two core components of metaverse characteristics—presence and interactivity—that

collectively define the experiential depth of virtual engagement. Presence encapsulated telepresence and continuity, aligning with earlier conceptualizations (Tseng et al., 2022), but was newly contextualized within socially embedded digital ecosystems. Interactivity extended beyond functional engagement, encompassing peer-generated content, social reciprocity, and economic exchange. This finding advances previous conceptual models (Go et al., 2021) by providing empirically validated constructs that capture the structural essence of sustainable engagement in virtual fashion contexts. Unlike prior descriptive approaches, this study offers an analytical framework that can be replicated in future quantitative investigations. As Zhang et al. (2023) observed, live and interactive retail experiences can translate into offline behavioral intentions, reinforcing the cross-channel influence of immersive commerce.

Second, presence and interactivity, as key metaverse characteristics, significantly influenced consumer attitudes and purchase intentions, reaffirming the psychological salience of immersive platform features in shaping sustainable consumer behavior. These findings imply that sustainability-related features—such as product traceability, eco-design elements, or digital authenticity—must be embedded within interactive and socially meaningful experiences to maximize behavioral impact. Presence and interactivity thus function not merely as technical affordances but as psychological catalysts that transform passive observation into participatory engagement. Extending this perspective, Lee and Kim (2024) demonstrated that consumers' perceptions of authenticity and creative agency in AI-generated fashion design significantly shape trust and attitudinal responses. These results underscore the role of authenticity as a mediating construct linking technological immersion to sustainable fashion acceptance. This observation aligns with Poggessi et al. (2022), who found that visually rich and interactive digital retail environments evoke stronger emotional responses, thereby reinforcing purchase intentions. Furthermore, the findings corroborate emerging evidence that metaverse-enabled co-creation enhances shopping well-being and sustainable brand experience (Hu et al., 2025).

Third, among the consumption values examined, epistemic, conditional, and social values significantly pre-

dicted consumer attitudes and purchase intentions, whereas emotional value showed a significant negative effect on purchase intention. This finding suggests that emotionally immersive experiences in the metaverse may evoke hedonic engagement that does not necessarily translate into sustainability-oriented purchasing decisions. In other words, heightened affective stimulation may shift consumer focus toward experiential enjoyment rather than environmentally responsible consumption, highlighting the complex and non-linear role of emotional value in digital sustainable fashion contexts. These results confirm that immersive sustainable fashion appeals to consumers' curiosity (epistemic), situational relevance (conditional), and social identity (social), consistent with Sheth et al.'s (1991) consumption value theory and its later adaptations (Hasbullah et al., 2020). Recent studies (Lee & Kim, 2025) have further shown that consumers attribute cognitive agency and creative competence to AI-based fashion creators, which enhances epistemic engagement and perceived value. This indicates that curiosity-driven exploration in metaverse fashion arises not only from novelty seeking but also from the recognition of machine intelligence and co-creative potential. The non-significant effect of functional value suggests an evolving consumer orientation: in virtual environments, symbolic and hedonic dimensions outweigh tangible product performance. This finding reflects a structural shift in fashion consumption, where digital embodiment and narrative participation increasingly replace material evaluation as drivers of consumer satisfaction.

Fourth, consumer attitude, as a proximal psychological response, strongly predicted purchase intention, reaffirming the applicability of the theory of reasoned action (Fishbein & Ajzen, 1974) in immersive digital contexts. Positive attitudes toward metaverse-based sustainable fashion products translate more directly into behavioral intentions, possibly due to the low-risk and socially liberated nature of metaverse environments. This reduces the traditional attitude-behavior gap observed in offline sustainable consumption, implying that digital platforms may facilitate a more seamless transition from awareness to action.

Finally, differences observed across levels of environmental awareness highlight the presence of meaningful

psychographic segmentation opportunities. Respondents with higher environmental awareness scored significantly higher on interactivity, functional, emotional, and epistemic values, as well as overall product attitudes. These results align with environmental psychology research (Hassan et al., 2022; Nuh et al., 2023), indicating that sustainability-conscious users are not only ideologically aligned but also cognitively and emotionally predisposed to engage with novel, immersive consumption modes. The absence of significant differences in social and conditional values suggests that environmentally aware consumers act primarily from intrinsic moral motivation rather than extrinsic or situational incentives. This distinction deepens our understanding of sustainable digital behavior, implying that effective strategies should focus on authenticity, empowerment, and meaningful participation rather than on superficial social signaling or trend-based appeals. While the findings indicate that immersive affordances can foster pro-environmental attitudes and strengthen behavioral intentions, causal inference remains limited due to the cross-sectional design. Although this study conceptually focuses on perceived sustainability, the absence of direct measures of material or lifecycle impact remains a limitation. Future research should operationalize both perceived and objective sustainability dimensions to comprehensively assess virtual fashion's environmental contribution.

Overall, this study enriches current metaverse consumer research by integrating sustainable consumption perspectives into an area previously dominated by visual, experiential, and brand-centric frameworks. Specifically, it examined how metaverse characteristics and multidimensional consumption values influence consumer attitudes and purchase intentions toward metaverse-based sustainable fashion products, and whether these relationships vary according to consumers' levels of environmental awareness. While epistemic, social, and conditional values strengthened both attitudinal and behavioral outcomes, emotional value demonstrated a negative relationship with purchase intention, suggesting that immersive affective experiences do not uniformly enhance sustainable purchasing behavior. The findings further highlight that platform affordances—particularly presence and interactivity—play a pivotal role in shaping sustainability-

oriented consumer responses. These results extend prior metaverse research by emphasizing sustainability-driven psychological mechanisms rather than purely technological or aesthetic factors. Theoretically, this research contributes to the digital fashion and metaverse literature by integrating platform affordances with sustainability-focused consumption frameworks. Practically, it offers actionable insights for brands and platform developers seeking to align technological interactivity with responsible, value-based consumption. Although these findings provide meaningful implications, causal inference remains limited due to the cross-sectional design. Future research should adopt longitudinal or experimental approaches to validate causal pathways and explore cross-cultural or generational variations in sustainable virtual fashion engagement, thereby deepening our understanding of how digital environments can promote sustainable consumer transformation.

This study offers several theoretical and practical contributions to virtual fashion and sustainable consumption research. First, it empirically identifies two core characteristics of immersive virtual fashion environments—presence and interactivity—and validates their multidimensional and interrelated nature. This extends prior fragmented conceptualizations by demonstrating how these constructs jointly enhance consumer experience, advancing digital fashion adoption and platform-based brand transformation (Chan et al., 2024; Profumo et al., 2024).

Second, by applying Sheth et al.'s (1991) consumption value theory, this research highlights the roles of epistemic, social, and conditional values within immersive sustainability contexts. Findings reveal that curiosity, social identity, and contextual relevance, rather than utilitarian motives, drive engagement with sustainable virtual fashion.

Third, integrating sustainability consciousness into a value-based framework bridges environmental psychology and digital consumer behavior, extending behavioral models from physical and online retail to virtual fashion environments. Presence and interactivity emerge not merely as technological affordances but as psychological catalysts that foster ethical involvement and pro-environmental attitudes.

Practically, designers and marketers of sustainable fashion brands should prioritize features that enhance

presence and interactivity to strengthen immersion, social connection, and brand trust. Embedding sustainability cues—such as eco-badges, circularity-linked NFTs, or digital material provenance—within interactive affordances can transform abstract eco-messages into experiential value.

Marketing efforts should emphasize novelty, ethical alignment, and social resonance through limited-edition digital collections or immersive campaigns tied to real-world sustainability initiatives. Environmentally conscious consumers respond most strongly to interactive, epistemic, and emotional values; thus, targeted strategies linking virtual experiences to tangible sustainability actions (e.g., carbon-offset programs or recycling incentives) are recommended.

Finally, this study introduces the notion of virtual fashion environment sustainability, suggesting a new strategic direction for developing immersive ecosystems that integrate eco-feedback and authenticity into digital fashion engagement.

Although this study examines metaverse-based fashion experiences, none of the respondents reported exclusive use of platforms that can be strictly classified as fashion-centered metaverse platforms. Instead, fashion-related experiences were derived from hybrid or game-oriented metaverse environments in which avatar customization and virtual fashion consumption are embedded as experiential layers rather than core platform functions.

This reflects the current developmental stage of the metaverse fashion ecosystem, where fashion operates as an experiential and symbolic component within multifunctional virtual platforms. Accordingly, the findings should be interpreted within the context of hybrid metaverse environments, and future research may benefit from platform-specific sampling as fashion-dedicated metaverse platforms further emerge.

References

- Ahn, S. E., Oh, C., & Yoon, T. K. (2021). A synthetic analysis of public survey on awareness of Korean towards the environment. *Journal of Environmental Policy and Administration*, 29(1), 47–75. <https://doi.org/10.15301/jepa.2021.29.1.47>
- Ball, M. (2022). *Metaverse: And How It Will Revolutionize Everything*. Liveright Publishing Corporation.
- Bazi, S., & Hajawi, D. A. (2025). Customer inspiration in the metaverse: Antecedents, mechanisms, and outcomes. *Journal of Retailing and Consumer Services*, 87, 104439. <https://doi.org/10.1016/j.jretconser.2025.104439>
- Blázquez, M. (2024). The metaverse and its potential for digital sustainability in fashion. *Journal of Global Fashion Marketing*, 15(3), 303–319. <https://doi.org/10.1080/20932685.2024.2339236>
- Boo, C. (2023). *Effects of metaverse characteristic factors on continuance intention: Mediating effects of experience values* [Master's thesis, Sungkyunkwan University].
- Chan, H. H. Y., Henninger, C., Boardman, R., & Blázquez Cano, M. (2024). The adoption of digital fashion as an end product: A systematic review. *Journal of Global Fashion Marketing*, 15(1), 1–18. <https://doi.org/10.1080/20932685.2023.2251033>
- Fishbein, M., & Ajzen, I. (1974). Attitudes towards objects as predictors of single and multiple behavioral criteria. *Psychological Review*, 81(1), 59–74. <https://doi.org/10.1037/h0035872>
- Foroudi, P. (2019). Influence of brand signature, brand awareness, brand attitude, brand reputation on hotel industry's brand performance. *International Journal of Hospitality Management*, 76, 271–285. <https://doi.org/10.1016/j.ijhm.2018.05.016>
- Fu, L., Sun, Z., Zha, L., Liu, F., He, L., Sun, X., & Jing, X. (2020). Environmental awareness and pro-environmental behavior within China's road freight transportation industry: Moderating role of perceived policy effectiveness. *Journal of Cleaner Production*, 252, 119796. <https://doi.org/10.1016/j.jclepro.2019.119796>
- Go, S. Y., Jeong, H. G., Kim, J. I., & Sin, Y. T. (2021). 메타버스의 개념과 발전 방향 [Concept and future direction of the metaverse]. *Korea Information Processing Society Review*, 28(1), 7–16.
- Hasbullah, N. N., Sulaiman, Z., & Mas'od, A. (2020). The effect of perceived value on sustainable fashion consumption in the era of COVID-19: A proposed conceptual framework. *International Journal of Academic Research in Business and Social Sciences*, 10(8), 895–

906. <https://doi.org/10.6007/IJARBS/v10-i8/7645>
- Hassan, S. H., Yeap, J. A., & Kumaim, N. H. (2022). Sustainable fashion consumption: Advocating philanthropic and economic motives in clothing disposal behaviour. *Sustainability*, 14(3), 1875. <https://doi.org/10.3390/su14031875>
- Hu, L., Olivieri, M., Giovannetti, M., & Cedrola, E. (2025). The retail strategies of luxury fashion firms in the metaverse: Enhancing brand experiences. *Journal of Retailing and Consumer Services*, 84, 104202. <https://doi.org/10.1016/j.jretconser.2024.104202>
- Jang, J. Y., Hur, H. J., & Choo, H. J. (2019). How to evoke consumer approach intention toward VR stores? Sequential mediation through telepresence and experiential value. *Fashion and Textiles*, 6, 1–16. <https://doi.org/10.1186/s40691-018-0166-9>
- Jia, Y., & Mvondo, G. F. N. (2025). Exploring the adverse effects of the metaverse on users' psychological well-being and self-esteem: A mixed-methods study. *Journal of Retailing and Consumer Services*, 86, 104321. <https://doi.org/10.1016/j.jretconser.2025.104321>
- Karp, D. G. (1996). Values and their effect on pro-environmental behavior. *Environment and Behavior*, 28(1), 111–133.
- Kim, J., Cho, A., Baek, T. H., Park, J., & Bae, J. (2025). The effect of NFT visual quality on consumer evaluations of luxury goods in the metaverse. *Journal of Retailing and Consumer Services*, 87, 104346. <https://doi.org/10.1016/j.jretconser.2025.104346>
- Kumar, A., Shankar, A., Behl, A., & Wamba, S. F. (2025). Do you believe in the metaverse NFTs? Understanding the value proposition of NFTs in the metaverse. *Technological Forecasting and Social Change*, 210, 123880. <https://doi.org/10.1016/j.techfore.2024.123880>
- Lee, G., & Kim, H. Y. (2024). Human vs. AI: The battle for authenticity in fashion design and consumer response. *Journal of Retailing and Consumer Services*, 77, 103690. <https://doi.org/10.1016/j.jretconser.2023.103690>
- Lee, G., & Kim, H. Y. (2025). Algorithm fashion designer? Ascribed mind and perceived design expertise of AI versus human. *Psychology & Marketing*, 42(1), 255–273. <https://doi.org/10.1002/mar.22124>
- Luong, V. H., Xiao, Y., Alamoudi, K. H., & Desmarchelier, B. (2024). Is digital fashion the future of the metaverse? Insights from online communities. *Journal of Retailing and Consumer Services*, 76, 103780. <https://doi.org/10.1016/j.jretconser.2024.103780>
- McBride, B. B., Brewer, C. A., Berkowitz, A. R., & Borrie, W. T. (2013). Environmental literacy, ecological literacy, ecoliteracy: What do we mean and how did we get here? *Ecosphere*, 4(5), 1–20. <https://doi.org/10.1890/ES13-00075.1>
- Minton, A. P., & Rose, R. L. (1997). The effects of environmental concern on environmentally friendly consumer behavior: An exploratory study. *Journal of Business Research*, 40, 37–48.
- Nuh, A., Munir, M. M., & Muhibban, M. (2023). Fashion engagement and pro-environmental attitudes: Drivers of sustainable fashion consumption in Indonesia. *Journal of Enterprise Development*, 5(3), 460–478. <https://doi.org/10.20414/jed.v5i3.7292>
- Park, H., & Lim, R. E. (2023). Fashion and the metaverse: Clarifying the domain and establishing a research agenda. *Journal of Retailing and Consumer Services*, 74, 103413. <https://doi.org/10.1016/j.jretconser.2023.103413>
- Periyasamy, A. P., & Periyasami, S. (2023). Rise of digital fashion and metaverse: Influence on sustainability. *Discover Sustainability*, 4, 31. <https://doi.org/10.1007/s44265-023-00016-z>
- Poggesi, S., Mari, M., Kamangar, A., & Schilleci, P. (2022). The role of virtual environment in online retailing: State of the art and future perspectives. *Sustainability*, 14(7), 4131. <https://doi.org/10.3390/su14074131>
- Profumo, G., Testa, G., Viassone, M., & Ben Youssef, K. (2024). Metaverse and the fashion industry: A systematic literature review. *Journal of Global Fashion Marketing*, 15(1), 131–154. <https://doi.org/10.1080/20932685.2023.2270587>
- Putrevu, S., & Lord, K. R. (1994). Comparative and noncomparative advertising: Attitudinal effects under cognitive and affective involvement conditions. *Journal of Advertising*, 23(2), 77–91.
- Rausch, T. M., Baier, D., & Wening, S. (2021). Does

- sustainability really matter to consumers? Assessing the importance of online shop and apparel product attributes. *Journal of Retailing and Consumer Services*, 63, 102681. <https://doi.org/10.1016/j.jretconser.2021.102681>
- Salisbury, W. D., Pearson, R. A., Pearson, A. W., & Miller, D. W. (2001). Perceived security and World Wide Web purchase intention. *Industrial Management & Data Systems*, 101(4), 165–177.
- Sheth, J. N., Newman, B. I., & Gross, B. L. (1991). Why we buy what we buy: A theory of consumption values. *Journal of Business Research*, 22(2), 159–170.
- Tan, W. K. (2018). Gamification in aquarium context: Intention to play game that imparts knowledge and promotes marine animal conservation. *Information Technology & People*.
- Tseng, F. C., Huang, T. L., Pham, T. T. L., Cheng, T. C. E., & Teng, C. I. (2022). How does media richness foster online gamer loyalty? *International Journal of Information Management*, 62, 102439. <https://doi.org/10.1016/j.ijinfomgt.2021.102439>
- Xin, B., Song, Y., Tan, H., & Peng, W. (2025). Sustainable digital fashion in a metaverse ecosystem. *Journal of Retailing and Consumer Services*, 82, 104395. <https://doi.org/10.1016/j.jretconser.2024.104395>
- Zhang, P., Chao, C.-W. F., Chiong, R., Hasan, N., Aljaroodi, H. M., & Tian, F. (2023). Effects of in-store live stream on consumers' offline purchase intention. *Journal of Retailing and Consumer Services*, 72, 103262. <https://doi.org/10.1016/j.jretconser.2023.103262>