

**Harnessing virtual influencers for technological sustainability in the fashion industry:  
Impacts on consumer behaviour and eco-friendly practices**

Arshad Hussain<sup>1</sup>, Dr. Ravi Vyas<sup>2</sup>, Dr. Anupam Narula<sup>3</sup>, Gaganjeet Singh<sup>4</sup>, and Rupam Jyoti Deka<sup>\*5</sup>

<sup>1</sup>Bennett University, India

<sup>2</sup>Associate Professor, Department of Commerce, Medicaps University, Indore India

<sup>3</sup>Professor of Marketing, Lal Bahadur Shastri Institute of Management, Delhi India

<sup>4</sup>Sr. Faculty, School of Retail and Fashion Merchandise, Footwear Design and Development Institute, Noida, India

<sup>5</sup>Assistant Professor, Bharati Vidyapeeth (Deemed to be University Institute of Management and Research), India

Emails: [ravi.vyas@medicaps.ac.in](mailto:ravi.vyas@medicaps.ac.in)<sup>2</sup>; [anupamnarula@lbsim.ac.in](mailto:anupamnarula@lbsim.ac.in)<sup>3</sup>; [gaganjeet@fddiindia.com](mailto:gaganjeet@fddiindia.com)<sup>4</sup>; [hussainarshad5051@gmail.com](mailto:hussainarshad5051@gmail.com)<sup>1</sup>

\*Correspondence: [rupam.das@bharatividyaapeeth.edu](mailto:rupam.das@bharatividyaapeeth.edu)

**Abstract**

Virtual influencers (VIs), defined as computer-generated social media personas powered by artificial intelligence and CGI technology, are increasingly deployed in sustainability-oriented fashion marketing, yet their capacity to translate pro-environmental attitudes into actual purchase behaviour among digitally native consumers remains poorly understood. This study examines how four core VI attributes, namely authenticity, transparency, interactivity, and information support, activate the three determinants of the Theory of Planned Behavior (TPB), specifically attitude, subjective norms, and perceived behavioural control, and whether this activation can reduce the well-documented attitude-behaviour gap in sustainable fashion among Generation Z. Employing a sequential mixed-methods design, 40 semi-structured interviews were conducted and analysed through Braun and Clarke's thematic analysis, followed by a structured online survey administered to 250 Generation Z social media users. Multiple regression analysis, supported by Pearson correlation and ANOVA, reveals that trust ( $\beta = 0.38$ ), interactivity ( $\beta = 0.33$ ), authenticity ( $\beta = 0.30$ ), and transparency ( $\beta = 0.28$ ) are all significant positive predictors of sustainability-related consumer engagement, collectively accounting for 76 percent of variance in the outcome ( $R^2 = 0.76$ ,  $F = 52.98$ ,  $p < 0.001$ ). Qualitative themes corroborate these findings, identifying credibility, visual appeal, and meaningful interaction as pivotal drivers of eco-friendly purchase motivation. The study extends TPB-based sustainability research by positioning VI characteristics as

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psychological antecedents of attitude, normative pressure, and perceived control, rather than as direct predictors of behavioural outcomes. Practical implications are offered for fashion marketers, platform regulators, and policymakers seeking to leverage AI-generated personas for ethical, transparency-grounded sustainability communication.

**Keywords:** Virtual Influencers, Sustainable Fashion, Generation Z, Theory of Planned Behavior, Consumer Behaviour, Attitude Behaviour Gap, Authenticity, Transparency, Digital Marketing, Influencer Marketing, Eco-Friendly Consumption

**JEL Classification:** M31, M37, D12

## 1. Introduction

The rapid proliferation of Artificial Intelligence (AI) and the Internet of Things (IoT) is leading to huge digital transformation processes across industries along with the rapid change in the global economy (Dwivedi et al., 2023). This trend harmonizes the digital world with the real world, as the fashion world is not different and is advancing into the "fashion 4.0" era. For example, computer-generated images (CGI) are nowadays widely used in various aspects of design, production, visualization, and marketing in fashion (Särmäkari, 2021). In the era of "Fashion 4.0," virtual 3D fashion, also called "digital fashion," has gained considerable media attention in recent times. One of the key reasons behind this shift was the COVID-19 restrictions, which made companies digitize their operations and upgrade user experience (Särmäkari, 2021). To maintain commercial operations, digital representations of fashion products had to take the place of celebrities, spokespeople, and models promoting them. Nowadays, more fashion businesses are collaborating with virtual celebrities and producing digital copies of their goods. Consequently, partnerships between fashion firms and virtual influencers have expanded dramatically, enabling fashion products to be continuously promoted, even throughout the pandemic (McKinsey, 2023; Jhawar et al., 2023). Influencer marketing was already well known as a successful product promotion strategy prior to the rise of virtual influencers. Social media influencers have significantly increased their visibility over the last ten years and emerged as a significant substitute for traditional advertising (Khamis et al., 2017; Kádeková & Holienčinová, 2018; Jin et al., 2019). Internet influencers establish a closer bond with their audience than traditional celebrities do. This is because people may engage with these influencers directly on social media and actively participate in events that they host (Arsenyan & Mirowska, 2021). According to Djafarova and Rushworth (2017) and (Lou et al., 2023), consumers feel more connected and trusted because of this closer and more interactive relationship.

A virtual influencer is a computer-generated character designed to interact with and engage audiences on social media platforms (Arsenyan & Mirowska, 2021). These digital avatars are entirely fictional and are created using technology including 3D modeling, animation and artificial

intelligence (AI) (Conti et al., 2022). Anthropomorphized representations of virtual agents, especially visually attractive ones, elicit social responses and behavioral change in humans. As technologies are advancing, computer-generated imagery (CGI) technology, virtual influencers (VIs) are substantially garnering people's attention on social media platforms and further makes VIs to be designed easily (Moustakas et al., 2020). The fashion business started collaborating with virtual influencers in 2016. The public's attention was drawn to the first virtual influencers during this period, including Lil Miquela, Shudu, Noonouri and Naina. For instance, Lil Miquela took over the fashion brand's Instagram account while attending the Prada FW 18/19 show in Milan. Using virtual influencers at live fashion events was a concept that was pioneered by Prada (Hiort, 2021). Fashion firms consequently began collaborating with more virtual influencers for marketing and promotion, which aided in the growth and expansion of the industry (Arrigo, 2024; Hussain & Singh, 2026). Teams design virtual influencers by controlling personality, background, and appearance. This control allows a team to create and enhance the positive impact of the virtual influencer on the audience (Moustakas et al., 2020).

However, the high level of control over virtual influencers (VIs) has raised ethical concerns. According to Robinson (2020), a VI does not have its own mind, as it is completely controlled by its creators. Since all the content for VIs is planned by a team, the chances of them posting something politically incorrect or inconsistent with the brand are very low, ensuring the brand's best interests (Robinson, 2020). Now, virtual influencers (VIs) are not responsible for their words or actions since the content is created by the team behind them rather than the VI. Virtual influencers' biggest audience is Generation Z, who grew up in a digital world. CGI influencers have proven to be especially appealing to this group (SuperPixel, 2023). Gen Z includes people born between the mid-1990s and early 2000s, a time when the World Wide Web became widespread (Wood, 2013; Llopis-Amorós et al., 2019). Their digital upbringing makes them more accepting of technology. They are highly diverse, digital native and characterized by their fluency in technology and social media as they did not exist in the pre-internet age. Gen Z is often associated with traits like individualism, authenticity, and activism. They prioritize authenticity in their interactions and are quick to discern disingenuous content (Palomo-Domínguez et al., 2023). They are predominantly social conscious and actively engage in advocating for causes they believe in, such as environmental sustainability and social justice, still they prefer buying fast fashion (Evanilay & Millenia, 2024). Gen Z is socially conscious and expects brands to share their values. Companies should be transparent about their social stances and actively support causes that resonate with Gen Z's concerns, such as mental wellness, diversity, sustainability (Wood, 2022). However, elder consumers are more likely to purchase sustainable and eco-friendly goods Casalegno et al. (2022). The actual and valid reasons behind this act are still not clear, but existing studies have mentioned that older people might be able to afford these more expensive goods. This causes a disconnect between Gen Z's real shopping habits and their awareness of sustainability (Petro, 2022). This Inconsistency illustrates the well-substantiated attitude and behaviour gap in

sustainable fashion. As post-millennial generation regularly exhibit higher sense of responsibility pertaining to the environment yet these generation do not convert these attitudes into sustainable buying actions. The most recent body of work revealed that the attitude behaviour gap continues to remain even among Gen Z consumers who possess high level of awareness pertaining to the sustainability in fashion and environment (Ngo et al., 2024; Ge, 2024; Theocharis, 2025). This ongoing gap call attention to study technology-enabled approaches, particularly virtual influencers as key determinants of sustainable behaviour change among Gen Z. Sustainable fashion means producing and consuming clothing in ways that reduce environmental degradation and maintain social responsibility (Brundtland, 1985; Henninger et al., 2016). As technology evolves, digital fashion and computer-generated influencers are increasingly prominent as influential tools that create new opportunities and motivate sustainable consumption patterns (Mao et al., 2025). Virtual influencers may shape attitudes, but whether they facilitate eco-friendly behavior or minimize generation Z's sustainability attitude-behaviour relationship remains underexplored.

As it is inadequate about how virtual influencers motivate sustainability-oriented decisions among digitally native Gen Z consumers, this study addresses this gap by examining their behavioural impact in the context of sustainable fashion. With particular attention, the study explores how virtual influencers are in promoting sustainable fashion, influencing attitudes pertaining to the sustainability, and driving sustainable purchase choices. The core objective helps the study measure whether digital human influencers are capable of reducing the attitude behaviour gap in eco-friendly fashion.

## 2. Literature Review

Virtual personality has garnered growing intellectual attention withing the field of marketing and technology (Hofeditz et al., 2022). Despite, rising interest, research on virtual influencers is still scattered because notable theoretical and empirical limitations remaining. This evaluation integrates existing research and highlights unresolved debates that inspire the current study. One of the major reasons behind the rapid digitization is covid19 and progress in CGI innovation. This triggered the escalated utilization of virtual influencers (Batista da Silva Oliveira & Chimenti, 2021). AI influencers refer to the virtual influencers created using artificial intelligence technology, who can interact like real people on social media platforms and even set trends through their highly realistic appearances and personality settings (Moustakas et al., 2020). Their performance is often linked to carefully designed storylines that arouse human emotions, personality and relatability (Moustakas et al., 2020).

However, experts put forth that most existing studies focus on describing the characteristics of virtual influencers instead of critically examining how these identity hints influence actual behavior of consumers in sustainability context. Robinson (2020) underscores about identity and existence and question of ethics of virtual influencers, stressing that these influencers ultimately function as instruments who are controlled by human agents. Batista da Silva Oliveira & Chimenti

(2021) extended earlier studies by identifying five attributes that motivate the effectiveness of non-human influencers like: anthropomorphism, controllability, authenticity, scalability and attractiveness. Despite these identified features, empirical proof is lacking behind in affirming that how each attribute encourages consumer behavior resulting in a significant theoretical gap. Earlier research largely focused on theoretical definitions instead of behaviour-based outcomes, encouraging the evidence-based focus of the present study.

## **2.1 Human-Likeness and Technology Realism, and the Uncanny Valley Debate**

Human-likeness and behavioural realism play an important role in shaping users' acceptance of virtual agents (Kim et al., 2024). Foundational exploration posited that highly lifelike virtual avatars improve the level of trust and engagement (Nass et al., 1994; Pan et al., 2017). It has been concluded that plays a central role in strengthening the persuasive impact of virtual influencers (Lim and Lee, 2023). On the other hand, the "uncanny valley" effect validate that almost human looking digital characters may incite a sense of uneasiness when they do not reach complete human likeness (Mori et al., 2012). Human like visual and cognitive features in digital avatars deepens the higher level of affection, whereas human like behaviours further intensify emotional reactions (Batista da Silva Oliveira & Chimenti, 2021). Similarly, Moustakas et al. (2020) point out that it is still not clear whether audiences are more attracted to stylized, cartoon like virtual influencers, or to hyper realistic figures such as Lil Miquela. This lack of clarity solidifies the theoretical vagueness about how consumers make sense of varying realism in virtual influencers. In the latest wave of research, this area of inquiry deepens. Zhang (2025) identified that higher level of visual and mental human likeness increases credibility. However, it is evident that hyper realistic VI can diminish social presence through uncanny valley responses (Ju et al. 2024). The mixed findings indicate that the optimal point of realism is still vague.

## **2.2 Design of Virtual Influencers: Transparency, Agency, and Ethical Debates**

The mechanism behind the design of virtual influencers is still not clear. For instance, Brud, a company that designed Lil Miquela has kept it secret that how this digital avatar was designed (Robinson, 2020). This lack of transparency restricts intellectuals from completely understanding how these digital personas are programmed. Most of the existing studies refer to video games, animated videos for virtual influencers, where people participate based on emotions, personality and how the character looks (Lankoski, 2002; Sloan, 2015; Makryniotis, 2018; Choudhry et al., 2022). Recent research challenge whether brand owned or self-directed virtual personalities are more productive. Some intellectuals claim that brand owned virtual influencers deliver greater message control, while others argue that these characters are not authentic and honest because of skepticism (Ju et al. 2024).

Ethical problems are growing because newer and recent studies are focusing on authenticity and transparency, warning that virtual characters can misinform or misguide audiences about their human identity and unattainable beauty standards (Alim et al., 2025). This discrepancy introduces

questions about whether digital influencers can maintain their influence exceeding their uniqueness effect or their attractiveness will fade over time.

### 2.3 Gen Z Characteristics and Virtual Influence

These generations are lashed with being authentic, transparent, and independent (Twenge, 2017). They define diversity, equity and inclusion differently and their worldview affects their perception of virtual identities and representation (Seemiller & Grace, 2016; Chiu & Ho, 2023). They prefer interactive and engaging digital experiences (Asioso, 2023; Vasalou et al., 2008), and social media strongly shapes their attitudes (Khamis et al., 2017). However, limited studies directly connect these behavioural preferences to virtual influencer effectiveness, and virtually none examine whether VIs can influence Gen Z's sustainable consumption choices. This empirical gap motivates the current research. According to (McKinsey & Company, 2024), generation Z is the second-youngest generation, after millennials and before Generation Alpha. Their childhood experiences such as pandemic lockdowns, economic instability, and climate concerns have an impact on their conduct. Gen Z is idealistic, socially conscious, and cares for sustainability, equity, and inclusion (Sus, 2025). Racial justice and environmental sustainability are two of the biggest priorities of Gen Z.

Although, virtual influencers are gaining rapid traction in digital marketing, the existing body of research remains theoretically fragmented and empirically underdeveloped (Laszkiewicz & Kalinska-Kula, 2023). Conflicting findings on the role of human-likeness and the “uncanny valley,” unresolved tensions between controllability and authenticity in VI design, and contradictory evidence on whether virtual or human influencers are more persuasive indicate that the field still lacks conceptual clarity. Moreover, despite increasing commercial use of VIs for sustainability-oriented campaigns, little academic work has examined their effectiveness. The influence of VIs on Generation Z a demographic that dominates social media consumption remains insufficiently tested. These gaps collectively justify the present research, which aims to provide deeper empirical insight by comparing virtual and human influencers on trust, authenticity, and engagement while also exploring consumer perceptions in sustainability-related communication.

### 2.4 Theoretical Framework

#### 2.4.1 Introduction to the Theory of Planned Behavior (TPB)

TPB suggests that action is driven by behavioural intention and later influenced by three essential determinants such as attitude, subjective norms and perceived behavioural control (Ajzen, 1991). People are more likely to carry out a behaviour when they hold a positive evaluation of it. TPB has been extensively used in sustainability research, as sustainable purchasing decisions tend to be intentional cognitively driven rather than impulsive (Ajzen, 1991). Gen Z consumers often report pro-environmental values but continue to buy fast fashion, showing a continued attitude-behaviour gap with sustainable fashion. This gap continues because favourable attitudes on their own are not

enough unless supported by subjective norms and adequate perceived behavioral control. VIs can influencer these TPB components by:

- Framing sustainability as aspirational and fashionable, thereby influencing attitudes.
- Modelling desirable social trends, thereby influencing subjective norms.
- Simplifying decision-making and offering practical guidance, thereby enhancing perceived behavioural control.

Integrating VIs within TPB framework enables an assessment of whether digital personas can contribute to reduce the sustainability attitude–behaviour gap within the fast-fashion domain.

#### *2.4.2 Mapping TPB Constructs to Research Variables*

In order to extend the framework of TPB to virtual influencers, this study examines how attributes of virtual influencers function as psychological antecedents to the three core TPB constructs. The Authenticity and transparency displayed by VIs are anticipated to influence consumers' attitudes toward sustainable fashion, as such enhance credibility, reduce perception of persuasion, and create an emotional connection to sustainability messages (Mandarić et al., 2022). Interactivity, such as two-way communication and customized interaction are proposed to shape subjective norms by generating social signals and perceived expectations to align with the sustainable behaviours promoted by the VI (Liao, 2024). Overall, information support, such as advice, practical suggestions, and simplified decision, is expected to influence perceived behavioural control by making sustainable fashion decisions easier, accessible. In the present study, the Theory of Planned Behavior (TPB) is adopted as a conceptual and interpretive framework rather than as a fully estimated causal model. TPB is used to guide hypothesis development and to support the theoretical interpretation of observed relationships between virtual influencer attributes and sustainability-related consumer responses. The study does not aim to statistically test the complete TPB structure or its mediating mechanisms; instead, TPB serves as a theoretical lens through which the findings are explained. Accordingly, the proposed framework views authenticity, transparency, interactivity, and information as antecedents that influence attitude, subjective norms and perceived behavioural control which, in turn, affect sustainable fashion purchase intention.

### **2.5 Hypotheses Development**

Virtual influencers are intentionally designed to signal authenticity, transparency, interactivity, and informational value, yet prior research has seldom examined how these specific attributes activate TPB mechanisms in sustainable consumption (Djafarova & Rushworth, 2017; Moustakas et al., 2020). Existing work typically treats these traits as direct predictors of outcomes such as trust or purchase intention, rather than as antecedents of attitudes, subjective norms, and perceived behavioural control in a sustainability setting. The following hypotheses address this gap. The hypotheses proposed in this study are examined as theoretically informed predictive relationships

rather than as components of a simultaneous structural equation model. Each hypothesis is evaluated individually to assess its explanatory and predictive relevance, consistent with the exploratory objectives of the study.

### *2.5.1 Influence of Virtual Influencer Characteristics on TPB Constructs*

#### **Authenticity → Attitude**

Authenticity is a key credibility cue in influencer marketing, yet its influence on sustainability-related attitudes in the context of virtual influencers remains underexplored (Djafarova & Rushworth, 2017; Arsenyan & Mirowska, 2021). According to TPB, when a virtual influencer appears genuine in values and communication, consumers are more likely to develop favourable attitudes toward sustainable fashion messages. Thus, this study extends prior authenticity research by testing whether perceived authenticity specifically enhances attitude toward sustainable fashion in a virtual influencer context.

**H1:** Virtual influencer authenticity is positively associated with consumers' attitudes towards sustainable fashion.

#### **Transparency → Attitude**

Transparency can reduce persuasion resistance for human influencers, yet its attitudinal impact when the source is a non-human, computer-generated entity is not well established (Moustakas et al., 2020; Robinson, 2020). By signalling honesty and reducing perceptions of manipulation, transparency is expected to strengthen favourable evaluations of sustainability claims and mitigate scepticism toward VI-driven promotion. Accordingly, this study investigates whether transparency functions as a driver of sustainability-related attitudes rather than only as an ethical requirement.

**H2:** Virtual influencer transparency is positively associated with consumers' attitudes towards sustainable fashion.

#### **Interactivity → Subjective Norms**

Interactivity has been linked to engagement and parasocial relationships, but limited evidence shows whether personalised interaction from VIs creates normative social pressure to adopt sustainable fashion practices (Khamis et al., 2017; Lim & Lee, 2023). In TPB terms, interactive features such as replies, Q&A, and human-like conversational cues may create a perceived social environment in which sustainable choices are endorsed and expected. This study therefore examines whether VI interactivity shapes subjective norms rather than merely increasing engagement metrics.

**H3:** Information quality provided by virtual influencers is positively associated with consumers' attitudes towards sustainable fashion.

### **Information Support → Perceived Behavioural Control**

Guidance and information provided by VIs have not been systematically examined for their potential to reduce perceived barriers to sustainable fashion behaviour (Belanche, 2021). Clear recommendations, curated options, and practical tips can increase consumers' confidence in their ability to identify, afford, and integrate sustainable alternatives, thereby enhancing perceived behavioural control. This study extends prior work by conceptualising VI-provided information support as a facilitator of perceived control over sustainable fashion purchasing.

**H4:** Consumers' attitudes towards sustainable fashion are positively associated with their purchase intentions.

#### *2.5.2 Influence of TPB Constructs on Sustainable Fashion Purchase Intention*

According to TPB, attitudes, subjective norms, and perceived behavioural control are proximal predictors of behavioural intention. While this mechanism has been widely validated in other sustainability domains, it has not yet been tested where TPB determinants arise specifically from exposure to virtual influencers. The present study therefore applies the TPB structure to a VI-driven context of sustainable fashion.

**H5:** Virtual influencer interactivity is positively associated with consumers' purchase intentions.

**H6:** Purchase intention is positively associated with sustainability-related consumer responses.

**H7:** Perceived behavioural control over sustainable fashion purchasing positively influences sustainable fashion purchase intention.

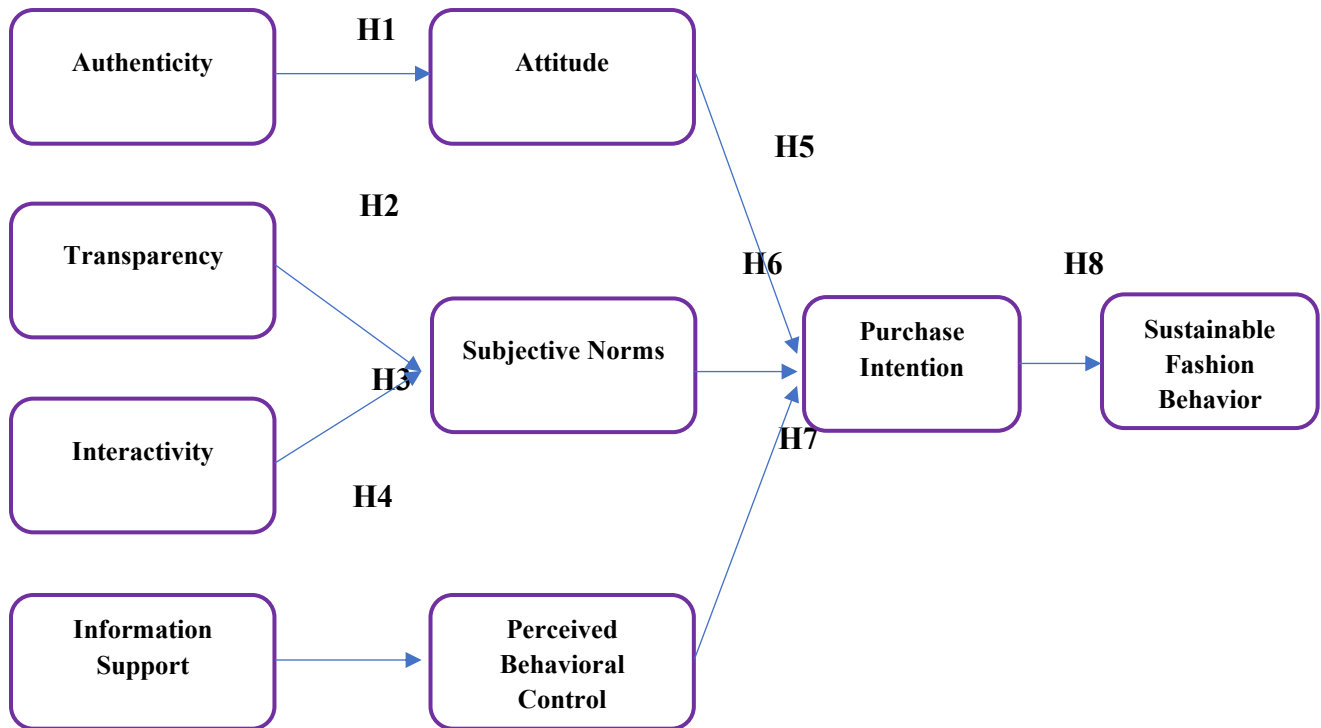
**H8:** Sustainable fashion purchase intention positively influences sustainable fashion behaviour.

All hypotheses are examined as theoretically informed predictive relationships between observed variables rather than as components of a mediated or structural model.

### **2.6 Contribution and Novelty of the Framework**

Figure 1. Conceptual framework extends the Theory of Planned Behavior by positioning virtual influencer characteristics as antecedents to its three core determinants, an integration that has not been systematically examined in prior work. Rather than treating credibility-related traits (authenticity, transparency, interactivity, information support) as independent, direct predictors of purchase outcomes, the model specifies how they activate attitudes, subjective norms, and perceived behavioural control, which then shape sustainable fashion purchase intention. By outlining these psychological pathways, the framework adds conceptual novelty in explaining how virtual influencers can help reduce the sustainability attitude–behaviour gap in fast-fashion consumption.

**Figure 1. Conceptual framework illustrating theoretically informed relationships among virtual influencer attributes and sustainability-related consumer responses**



This framework outlines how the characteristics (authenticity, transparency, interactivity, and information support) of these influencers activate the three TPB determinants such as attitude, subjective norms, and perceived behavioural control, later shapes consumers' sustainable fashion purchase intention and behaviour.

### 3. Methodology

This study used a sequential mixed-methods approach, beginning with a qualitative phase followed by a quantitative survey. This approach enables a deeper of how virtual influencers shape sustainability-related decision making, prior to testing these relationships through empirical testing. The method follows established mixed-methods procedures (Morse, 1991; Tashakkori & Teddlie, 2003; Creswell & Plano Clark, 2017) and was chosen to ensure that the constructs of the Theory of Planned Behavior (TPB) were firmly grounded within the context of virtual influencers (VIs) and sustainable fashion. The complete methodological framework is shown in Figure 3.

#### 3.1 Rationale for Using a Mixed-Methods Design

Integrating both qualitative and quantitative research approaches within a single study is becoming increasingly significant (Tashakkori & Teddlie, 2003; Creswell & Plano Clark, 2017). The premise

is that combining the unique advantages of each method within a mixed-methods design can be more productive. In this way, using mixed approach can become highly valuable in research, as insights generated from multiple approaches can broaden and deepen understanding of the topic. Mixed method can inspire new perspectives, help address questions that are difficult to resolve through a single traditional method. The application and use of mixed methods have only been reviewed in a small number of disciplines (Creswell & Plano Clark, 2017; Wasti et al., 2022). Although the Theory of Planned Behavior offers a strong foundation for predicting sustainability-related choices, but research shows that virtual influencer characteristics such as authenticity, transparency, interactivity, and information facilitation are context-dependent (Djafarova & Rushworth, 2017; Moustakas et al., 2020; Khamis et al., 2017). Prevailing TPB scales do not completely capture how these constructs operate in the digital influencer environment (Creswell & Plano Clark, 2017; Venkatesh et al., 2013). Therefore, a qualitative phase was necessary to:

- Explore how Gen Z interpret VI attributes related to sustainable fashion.
- Identify behavioural and psychological patterns.
- Ensure that quantitative scale items were grounded in real experiences rather than assumptions.
- Strengthen construct validity before statistical testing.

This is consistent with the views of Creswell & Plano Clark (2017) and Venkatesh et al. (2013), who suggest that qualitative insights improve the accuracy and relevance of quantitative measures in new and evolving research areas.

### **3.2 Phase 1: Qualitative Study**

The participants were social media users who regularly follow virtual influencers and interact with fashion-related content online. The respondents were filtered to ensure that they fall under Generation Z to maintain the focus of the study on digitally native consumers, whose online behaviour and sustainability perspective is the core of the research. This filtration has maintained relevance to the target respondents without limiting participation to any fixed age range.

#### *3.2.1 Data Collection*

A total of 40 semi-structured interviews were scheduled using digital platforms such as Zoom and Microsoft Teams which majorly focused on:

- Perceptions of VI authenticity, transparency, and credibility
- Experiences with interactivity and engagement
- Perceived influence of VIs on sustainable fashion attitudes
- Barriers and motivations linked to eco-friendly fashion choices

### 3.2.2 Data Analysis

Interviews were transcribed word by word and analysed using Braun and Clarke's (2006) thematic analysis. Two independent coders reviewed transcripts and resolved discrepancies through discussion to ensure reliable and consistent coding.

### 3.3 Qualitative Insights Informing the Quantitative Phase

Themes identified in table 1 below were used to refine TPB constructs and develop survey items. Further, it ensured that the quantitative items measured how young consumer interprets VI's characteristics related to environment-friendly practices.

**Table 1. Mapping of Qualitative Themes to Quantitative Constructs**

Qualitative Theme	TPB Construct	Survey Item
VI genuineness and honesty	Attitude	This VI makes sustainable fashion seem appealing to me.
Transparency about being AI-generated	Subjective Norms	People important to me also trust transparent VIs.
Ease of understanding sustainable choices	Perceived Behavioural Control	This VI makes it easier for me to choose sustainable fashion.
High social media interactivity	Subjective Norms	The VI's interactions motivate me to follow sustainable practices.

### 3.4 Phase 2: Quantitative Study

An organized online questionnaire was circulated via social media channels in which participation was completely voluntary and anonymous. Participants were:

- Identified as Gen Z
- Netizens
- Follower of virtual influencer
- Familiarity with sustainable fashion

### 3.5 Instrument Development

All items were measured on a 5-point Likert scale that is 1 = strongly disagree, 5 = strongly agree.

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**Table 2. Key constructs and corresponding survey items**

Construct	Sample Measurement Item	Source
Authenticity	“The VI seems genuine.”	Djafarova & Rushworth (2017)
Transparency	“The VI openly discloses being AI-generated.”	Moustakas et al. (2020)
Interactivity	“The VI interacts with followers through replies and Q&A.”	Khamis et al. (2017)
Attitude	“Sustainable fashion feels appealing to me.”	Ajzen (1991)
Subjective Norms	“People important to me support sustainable fashion.”	Ajzen (1991)
Perceived Behavioural Control	“Choosing sustainable fashion feels easy and achievable.”	Ajzen (1991)
Purchase Intention	“I intend to purchase sustainable fashion promoted by this VI.”	Spears & Singh (2004); Schivinski & Dąbrowski (2016)

In order to maintain consistency that how each construct was implemented, a concise outline of the major survey items is presented in the table 2.

### 3.6 Reliability Assessment

To ensure the internal consistency of the measurement items, reliability analysis was conducted using Cronbach’s alpha. All constructs demonstrated acceptable reliability values, exceeding the recommended threshold of 0.70, indicating satisfactory internal consistency of the scales used in the study. Given that the analysis focuses on observed variables and employs multiple regression rather than latent variable modelling, additional construct validity assessments such as composite reliability, average variance extracted, and discriminant validity tests were not applicable.

### 3.7 Data Analysis Procedure

The quantitative data were analysed using IBM SPSS Statistics (Version 30). Given the exploratory nature of the study and the objective to examine predictive relationships between

virtual influencer attributes and sustainability-related consumer responses, multiple regression analysis was adopted as the primary analytical technique. Although the conceptual framework is informed by the Theory of Planned Behavior (TPB), the present study does not aim to estimate a full structural equation model. Instead, TPB is employed as a theoretical lens to guide hypothesis development and interpretation of relationships. Multiple regression is appropriate in this context because the analysis focuses on direct effects between observed variables rather than on the simultaneous estimation of latent constructs or theoretical linkage. Following established statistical procedures (George & Mallery, 2020), the analysis was conducted in four stages. First, descriptive statistics were computed to summarise respondent characteristics and variable distributions. Second, Pearson correlation analysis was performed to examine initial associations among key constructs. Third, reliability analysis was conducted to assess the internal consistency of the measurement items. Finally, multiple regression analysis was employed to evaluate the extent to which virtual influencer attributes (authenticity, transparency, interactivity, and trust) predict sustainability-related consumer engagement and purchase-related responses.

Prior to regression analysis, standard assumptions were assessed. Multicollinearity was examined using variance inflation factors (VIF), which remained below accepted thresholds. Residual diagnostics indicated no major violations of linearity, normality, or homoscedasticity. Accordingly, the hypothesised relationships were tested through separate regression equations rather than as a simultaneous structural system. Multiple regression was selected over structural equation modelling because the study focuses on prediction-oriented analysis using observed variables and does not seek to estimate latent constructs or theoretical linkage, making regression a suitable and parsimonious analytical choice.

### **3.8 Ethical Consideration**

Collected data were analyzed using different statistical analytic techniques. Regression analysis was used to determine the level at which authenticity and sustainability-related engagement with VIs are associated with and might influence consumer purchase decisions. Descriptive statistics summarized data, whereas virtual influencers' effects were investigated by doing an inferential analysis.

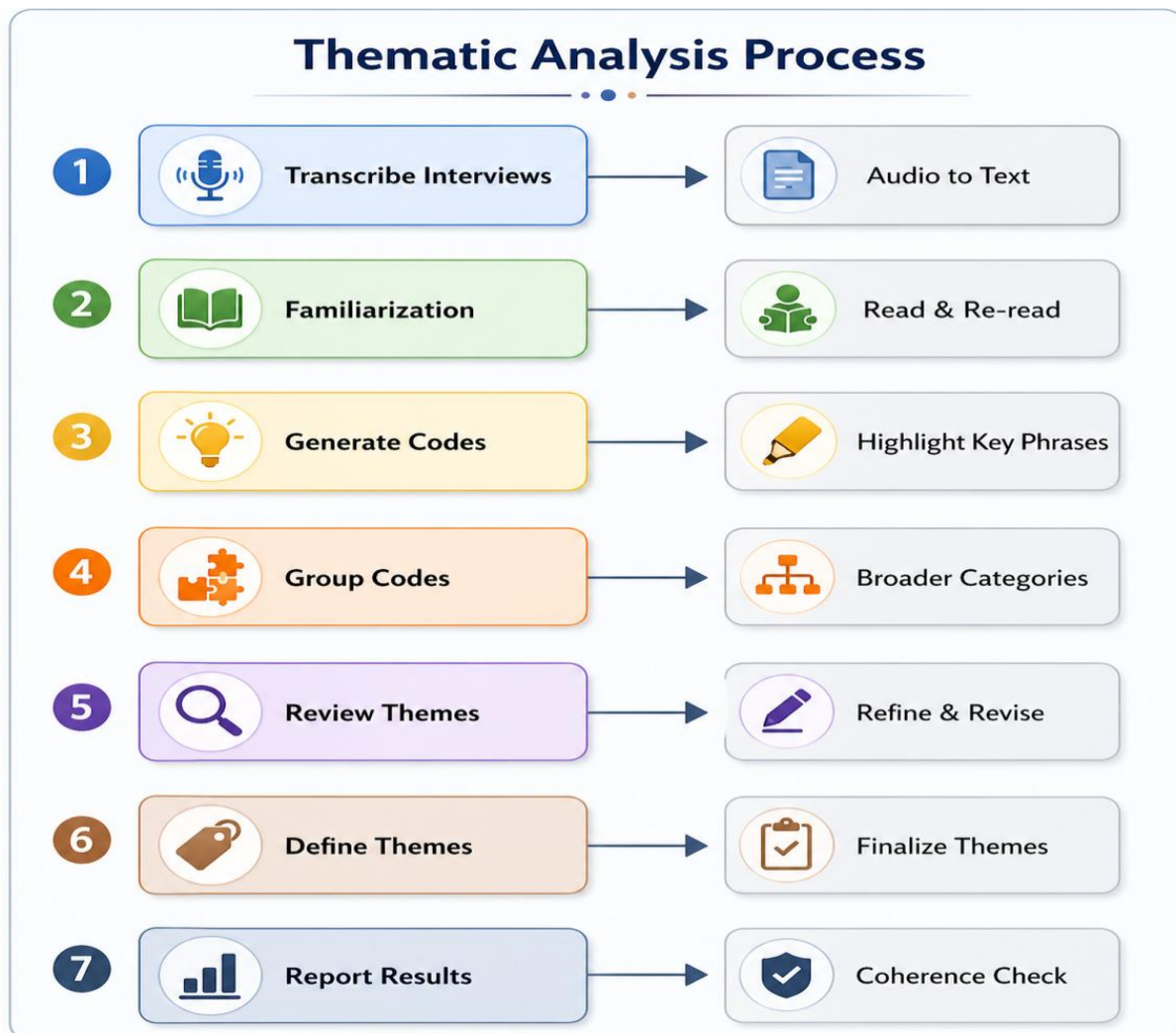
#### *3.8.1 Limitation*

The limitation of this research lies in the relatively small sample size used in the qualitative phase, which can limit the extent of generalizing the findings to a larger population. According to Lewis & Sauro, 2012, the mixed-method approach compensates for this problem by providing more detailed and comprehensive knowledge of the subject. Another limitation could be the fact that responses from self-reported survey data might be biased. Differences in the cultural and geographical backgrounds of the participants may affect the general applicability of such findings. The method is useful for interpreting and analyzing the impact of virtual influencers on consumer behaviour and sustainability.

### 3.8.2 Data Recording and Analysis

The interview recordings were thoroughly examined after being transcribed and processed thematic analysis, a widely applied method for analyzing qualitative data (Boyatzis, 1998). Despite growing popularity among researchers, qualitative approaches frequently face problems related to dependability and analysis (Patton, 1999; Belotto, 2018). Thematic analysis gives a systematic technique that helps address these problems (Braun & Clarke, 2006). It focuses on finding themes and patterns in the data, which provides robust and comprehensive understanding of the subject matter (Guest, 2012). It is a six-phase technique helps to identify vital themes from the research by structuring the data into meaningful patterns (Bernard & Ryan, 2016). The steps of the thematic analysis used in the study are outlined in figure 2.

**Figure 2. Thematic Analysis Steps**



#### 4. Findings and Discussion

The statistical results should be interpreted as evidence of predictive associations identified through regression analysis rather than as confirmation of a fully specified theoretical model. While the findings are consistent with the logic of the Theory of Planned Behavior, they reflect direct relationships between observed variables and do not imply mediation or indirect causal effects.

Table 3 demonstrates all the themes that have emerged from the thematic analysis of the interviews.

**Table 3. Themes, Subcodes, and Representative Quotes on Sustainable Fashion and Virtual Influencers**

Theme	Subcode	Description	Representative Quotes
Definition	General Definition	Products made with eco-friendly materials and ethical practices called Sustainable fashion.	Clothing produced in such a way that minimizes environmental impact.
Role of Virtual Influencers	Trendsetters	These are perceived as key players in making sustainable fashion relatable.	"They can significantly influence consumer choices by making sustainable fashion appealing."
Authenticity of Messages	Realness vs. Marketing	Several posts seen as authentic, while others feel like marketing strategies.	"I sometimes question their true commitment."
Trust Factors	Personal Stories	Trust and credibility enhance when influencers share personal sustainability experiences.	"I trust them more when they share real experiences."
Impact on Purchasing Decisions	Influenced Purchases	Respondents believed that they have made	"Yes, I bought a sustainable jacket after seeing it on a



		recommended purchase.	virtual influencer's page."
	Changing Consumer Behavior	They are seen as changing way the consumers approach sustainable fashion.	"They influence my choices towards more sustainable options."
Engagement with Content	Active Participation	Respondents actively engage with sustainability content by liking and sharing posts.	"I engage regularly; I comment and share their posts about sustainability."
	Content Sharing	Sharing content with friends is a common action taken after engaging.	"I often share their content with friends."
Emotional Response	Inspiration	Many feels inspired by virtual influencers promoting sustainable fashion.	"I feel inspired and hopeful."
	Skepticism	Some respondents' express skepticism about the influencers' genuineness to sustainability.	"I feel skeptical if it seems too commercialized."
	Video Content	Videos showcasing production processes and sustainable practices are favored.	"I prefer videos that show how sustainable products are made as it is engaging."
Preferred Content Types	Informative Content	Infographics and storytelling videos are also popular.	"I enjoy videos that highlight the impact of sustainable choices."
	Visual Appeal	The aesthetic quality of influencers' content is crucial for attracting attention.	"Good visuals can grab attention quickly."
Importance of			



Visual Presentation	Effective Communication	Attractive visuals help convey sustainability messages effectively.	"Visually appealing content can capture attention and communicate messages."
Need for Transparency	Transparency in Practices	Respondents emphasize the importance of transparency in partnerships and practices.	"They should focus on transparency and share more about their personal sustainability journeys."
	Building Trust	Transparency is seen as essential for building trust with followers.	"Transparency builds trust and shows their commitment to sustainability."
Future Role of Virtual Influencers	Continued Influence	Respondents claim that virtual influencers will play a significant role in encouraging sustainability.	"They will be key players in promoting sustainable fashion as a norm for our generation."
	Normalizing Sustainability	They are expected to help normalize sustainable practices in fashion.	"They will help shape sustainable fashion trends for future consumers."
Perceptions of Sustainability	Positive Perceptions	Virtual influencers shape positive perceptions of sustainable fashion.	"They can help make sustainable fashion popular among young people."
Awareness of Sustainable Practices	Educational Influence	Virtual influencers raise awareness and educating consumers about sustainability.	"I've become more aware and interested in sustainable fashion because of their influence."
	Influence on	Many consumers	

Behavioral Changes	Purchasing Decisions	report changing their purchasing behaviors based on recommendations from virtual influencers.	"Purchased a sustainable jacket after viewing it on a VI's profile."
Engagement	Active Participation	Consumers deliberately engage with sustainability content.	"I engage regularly, comment and share their posts about sustainability."
Emotional Connection	Inspirational Influence	Influencers evoke feelings of to adopt eco practices.	"Feel inspired when I see them promoting sustainable fashion."
Skepticism and Trust Issues	Authenticity Concerns	Several consumers express skepticism about the authenticity of influencer.	"I sometimes question their true commitment to sustainability."
Influence on Brand Perception	Enhanced Appeal	VIs can increase perception of brands related with sustainability.	"Virtual influencers influence my choices towards more sustainable options."
Normalization of Sustainability	Standard Practice	Virtual influencers help normalize sustainable fashion within consumer culture.	"They will be prominent players in promoting sustainable fashion in coming years."
Diverse Representation	Cultural Inclusivity	The demand for diverse representation among virtual influencers is felt.	"We need more Indian representation in sustainability."

### a) Sustainable Fashion

Majority of the respondents highlighted the need to protect environment and ensure ethical working conditions.

*“Sustainable fashion means creating products responsibly through eco-friendly materials and offering better conditions to work.”*

### **b) Role of Digital Avatars**

Respondents accentuated that virtual influencers support sustainability and set trends. As few participants stated that *“Virtual influencers can make sustainable fashion more appealing to the youth by creatively presenting fashionable, environmentally responsible choices.”*

### **c) Authenticity of the Messages**

According to the respondents, the success of virtual influencers is mostly based on authenticity. While some were not sure of their actual objectives, others trusted their words when they did not feel like marketing.

*“Some virtual influencers genuinely promote sustainability by educating their audience and supporting ethical brands, but many just seem to follow the trend, making it hard to tell if they truly care or not.”*

### **d) Trust**

According to the participants, the influencers who are transparent about their connections and activities share their personal sustainability stories make them trusted.

*“Consumers have shown a preference and formed a strong belief that virtual influencers are more credible when they are open and honest with their sponsorships, actively promote sustainability.”*

### **e) Impact on Purchasing Decisions**

Most participants recognized that virtual influencers influenced their buying decisions of eco-friendly clothes.

*“A section of the users participates actively through the channel by like, share, and comment on the posts whereas the other merely read the post feed without engaging much. This depends on the level of realism and the level of concern with the issue in question.”*

### **f) Emotional Response**

Many respondents stated that sustainability messages coming from virtual influencers inspired them. Others became skeptical right away, especially when the content looked too professional, or business related.

*“Influencers can make many people feel motivated and optimistic when they discuss sustainability, but others feel uncertain whether they actually do or if they are just trying to push products for marketing purposes.”*

### **g) Importance of Visual Presentation**

Visually appealing material was emphasized to be the significance for capturing participants' attention.

*"Attractive visuals attract views and multiply the effects of the message. A beautiful and easy-to-understand post or video makes sustainability more attractive."*

#### **h) Transparency**

Virtual influencers need to open and transparent about their activities considering many respondents. The transparency of partnership and green ventures increases trust and confidence, which influences consumer behavior.

*"Of course! Openness breeds trust. People care to know if influencers are only promoting businesses or if they truly care about sustainability. Their message is more believable when it comes from the heart."*

#### **i) Future of Virtual Influencers**

Participants highlighted that virtual influencers could be increasingly indispensable while promoting of sustainable fashion.

*"They can make sustainability become more popular and encourage more people to opt for green clothing."*

#### **j) Emotional Connection**

Participants felt an emotional connection to virtual influencers, motivating them to behave in a more sustainable manner.

*"Some are hoping and excited, while other people are a bit sceptical. Some influencers, it seems, are promoting trends; others seem to be the real deal."*

#### **k) Influence on Brand Perception**

Participants said they view brands related to virtual influencers more attractive and creditworthy.

*"Virtual influencers could make changes in people's perception toward a company. If they positively endorse a green company, their confidence increases with them."*

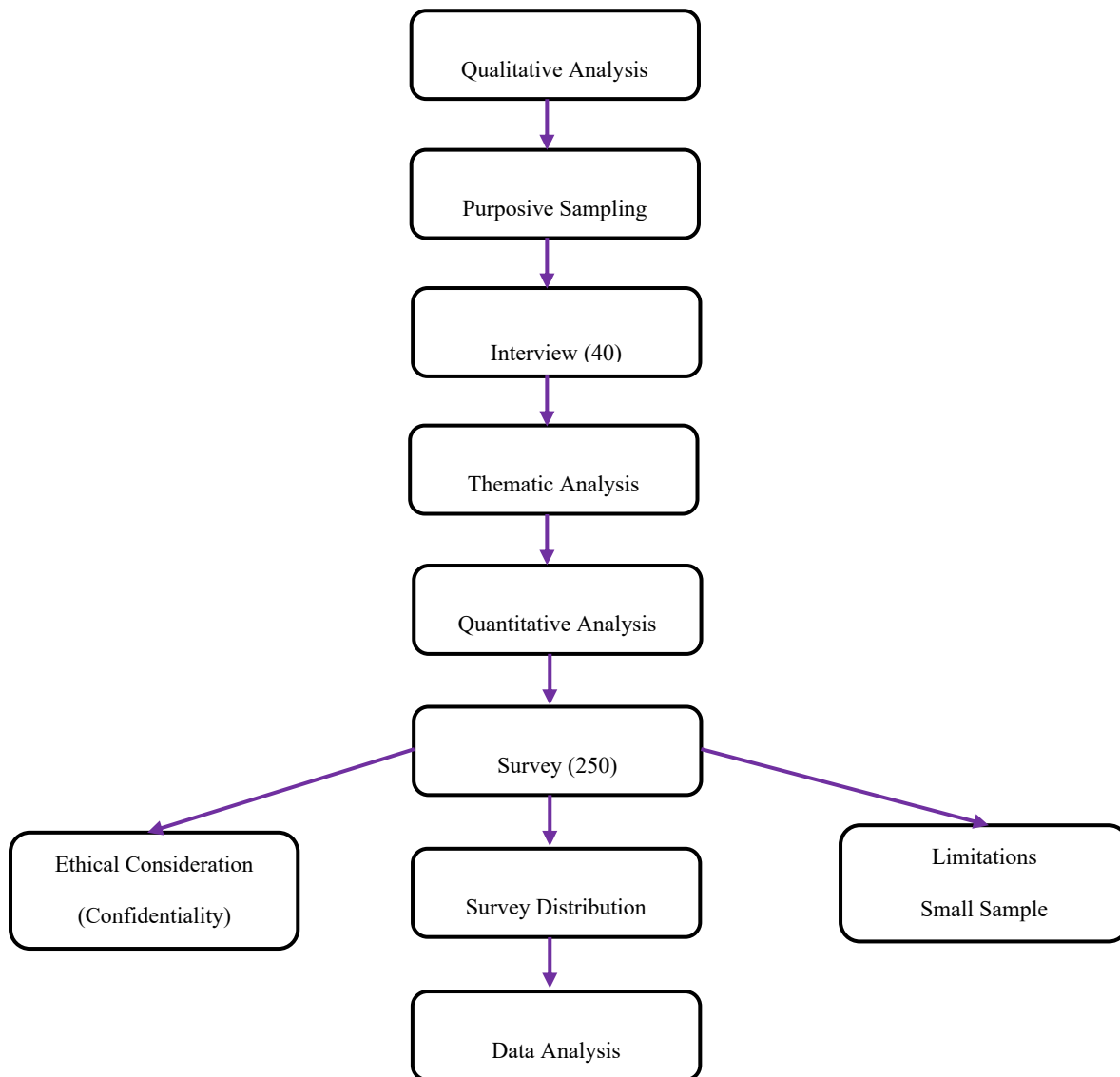
#### **l) Diverse Representation**

Many respondents stated that the messages of virtual influencers are more inclusive and relevant because of the variety they provide. This openness helped in going to a larger audience with sustainability messaging.

*"This is simpler when virtual influencers have diverse backgrounds. They may well have the power to attract a wider audience and promote sustainability from diverse cultures and lifestyles through their representation."*

These digital avatars play a pivotal role in promoting sustainable fashion by making it trendy, accessible, and relatable with the audience (Jacobson & Harrison, 2022). Respondents praised and valued the ability of the virtual influencers to inspire eco-conscious purchasing decisions. Transparency and Authenticity appeared as important factors in building trust and credibility, when influencers shared personal stories and behind-the-scenes content. Visually appealing and educational content on sustainable clothing production was highly preferred by the audiences. Emotional connections with the influencers encouraged this to happen, though skepticism sometimes reduced this effect.

**Figure 3. Theoretical Framework**





#### 4.1 Correlation Matrix

The results indicate that virtual influencer attributes are significantly associated with sustainability-related consumer responses. The correlation matrix (Table 4) shows positive and strong associations among the variables. Trust demonstrates strong correlations with authenticity ( $r = 0.77$ ) and transparency ( $r = 0.83$ ), suggesting that these attributes tend to co-occur at the bivariate level. Engagement is also strongly correlated with interactivity ( $r = 0.80$ ) and trust ( $r = 0.75$ ), indicating that higher perceived interactivity and trust are associated with greater audience engagement. To examine the predictive strength of these attributes while controlling for other variables, multiple regression analysis was conducted (Table 5). Trust emerged as the strongest predictor of engagement ( $\beta = 0.38, p < 0.001$ ), followed by interactivity ( $\beta = 0.33, p < 0.001$ ), authenticity ( $\beta = 0.30, p < 0.001$ ), and transparency ( $\beta = 0.28, p = 0.001$ ).

The model makes evident robust explanatory power, with an  $R^2$  of 0.76 displayed in table 6. It presents that psychological factors related to TPB such as interactivity, transparency, perceived capability and authenticity work together to anticipate continued engagement with sustainability content. The ANOVA results (Table 7),  $F = 52.98, p < 0.001$ , also validate the statistical significance of the unified predictors. Although, transparency, trustworthiness and authenticity were not only the strongest predictors, but they also contributed strongly, forming a basis for credibility which improves the level of engagement. Apart from explained predictors, undefined variances indicate that other psychological factors or variables may influence the behaviour pertaining to the sustainability, underscoring the need for further research.

**Table 4. Results of Correlation Matrix**

Variable	Engagement	Trust	Authenticity	Transparency	Interactivity
Engagement	1.000	0.75**	0.68**	0.72**	0.80**
Trust	0.75**	1.000	0.77**	0.83**	0.78**
Authenticity	0.68**	0.77**	1.000	0.80**	0.74**
Transparency	0.72**	0.83**	0.80**	1.000	0.79**
Interactivity	0.80**	0.78**	0.74**	0.79**	1.000

Source (s): The Authors

#### 4.2 Regression Coefficients Table

The regression coefficients indicate the relative predictive contribution of each independent variable to the dependent variable while controlling for the effects of other predictors in the model.

**Table 5. Results of Regression Coefficient**

Variable	Unstandardized Coefficients (B)	Standardized Coefficients (Beta)	t-Statistic	p-Value
Constant	1.25	-	3.58	0.001
Trust (X1)	0.45	0.38	5.12	0.000
Authenticity (X2)	0.32	0.30	4.62	0.000
Transparency (X3)	0.29	0.28	3.45	0.001
Interactivity (X4)	0.35	0.33	4.85	0.000

Source (s): The Authors

**Table 6. Summary of Model Table**

R	R <sup>2</sup>	Adjusted R <sup>2</sup>	Std. Error of the Estimate
0.87	0.76	0.75	1.24

Source (s): The Authors

**Table 7. Results of ANOVA**

Source	Sum of Squares	df	Mean Square
Regression	228.24	4	57.06
Residual	72.12	245	0.294
Total	300.36	249	

Source (s): The Authors

Broadly, the results validate that virtual influencers stimulate engagement in sustainable fashion not only through visual contents but also through social, cognitive and control-belief factors of

TPB. Overall, findings add to the sustainability literature by presenting that virtual influencers reduce the gap between attitude and behaviour. The quantitative findings also imitate the qualitative insights where the respondents have pin-pointed that trust, transparency and meaningful interaction as essential factor for responsiveness which strongly strengthens these outcomes.

The findings of the study should be interpreted as predictive associations identified through multiple regression analysis rather than as confirmation of a fully specified TPB-based model. While the results are theoretically consistent with the logic of the Theory of Planned Behavior, TPB is employed as an interpretive framework rather than as a statistically tested mediation model. Accordingly, the findings highlight how virtual influencer attributes are associated with sustainability-related engagement without implying causal or indirect effects.

## 5. Conclusions, Implications, Limitations, and Future Research Directions

The study aims to increase the growth potential of virtual influencers to nurture the actions of sustainability. It takes place in a condition where environmental awareness and virtual participation are becoming major priorities. Cutting-edge technology such as CGI, AI and virtual influencers can bring together sensible behavior and awareness pertaining to sustainability. The findings disclose that interactions and perception buildings are the significant constituents that explicitly persuade the consumer choice. Even though credibility, trust and transparency do not show clear statistical significance in the regression analysis. Still, it was made evident that these factors were integral to improve the level of participation and perception. At the same time, it enhances the durability and credibility of the relationship between consumers and virtual influencers. The study also discloses that while adopting sustainable practices, there are thousands of challenges that hinder growth. These barriers can be conquered by transparent communication, trustworthiness and affordability. Record brings to light that virtual influencers are not only state of the art but also play a central role in nurturing sustainable consumer spending. Virtual influencers are alluring among the tech savvy generation as it makes sustainability seem accessible, achievable and desirable. Although the results have also shown that it would be optimal to have ethics taken into the account when developing and making use of VIs in the means of transparency and reducing the opportunity for abuse or misapplication by consumers (Robinson, 2020). The findings addressing the research gaps, provide significant implications for practitioners and policymakers and insights into how virtual influencers can drive consumer behaviours make a notable contribution to the extant knowledge of sustainability marketing and virtual influencers. This study finds out that end consumer behavior to sustainable fashion based on the perception-building engagement and participation. It demonstrates that the so-called good people willing to sacrifice for anti-environmental behavior, could be interested in interactive engaging and creative forms like surveys, live sessions and storytelling (Arsenyan & Mirowska, 2021; Lou et al., 2022).



It also covers some practical and ethical issues such as costs, skepticism and transparency. Offering a trust base and stimulating sustainable consumption also involves the provision of a cheaper option, which is transparent about its relations and sustainability promises (Robinson, 2020). The study shares a new and fresh perspective that how the CGI and virtual influencer can shape environment friendly attitude (Moustakas et al., 2020; Kim et al., 2024). Hence, it aligns well when it comes to authenticity, diversity, and interactivity (Twenge, 2017; McKinsey, 2024). Some final recommendations can be made regarding legislation and marketing to leverage the opportunities presented by VIs, barring transparency and participation issues, to make certain that sustainable solutions are readily available. The foremost obligation of a policymaker must thus be that of creating the necessary ethics that will guide the use of VIs into marketing (Batista da Silva Oliveira & Chimenti, 2021). The study presents insights on how virtual influencers can be used to further sustainability in the fashion industry with good design and ethical leadership in view, contributing to encouraging sustainable consumer behavior.

### 5.1 Practical and Social Implications

This study advances sustainability marketing theory by demonstrating how virtual influencer characteristics activate specific psychological pathways that lead to sustainable fashion engagement. Although prior work has linked influencers to eco-friendly behaviour (Fayyaz et al., 2025), the present findings clarify how virtual influencers shape sustainable decision-making by influencing the three determinants of the Theory of Planned Behavior. Authenticity and transparency helped cultivate more favourable attitudes, interactivity strengthened subjective norms, and informational cues enhanced perceived behavioural control, collectively increasing sustainable purchase intentions among Gen Z (McKinsey & Company, 2024). Unlike previous research that emphasised broad credibility outcomes or influencer–follower trust dynamics (Gerrath et al., 2024), this study offers a mechanism-based understanding of persuasion by mapping virtual influencer attributes to the cognitive, normative, and control-belief structures that drive pro-environmental behaviour. This strengthens theoretical clarity in sustainability marketing by showing that virtual influencers reduce the widely documented attitude–behaviour gap not through surface-level promotional appeal but by activating the underlying TPB constructs that enable behavioural change. This study highlights the problems of both an ethical and a technology nature with regard to using AI powered digital personas as mediators for sustainability messages. Participants expressed their concern that very realistic virtual influencers can create a perception of authenticity and relational warmth, while at the same time lacking the accountability of humans, which could lead to algorithmic manipulation, increased parasocial vulnerability, and the use of AI to assist green washing.

While Virtual Influencers may be an environmentally destructive phenomenon if misused, they can also be used ethically to support good environmental communication by educating people with truthful information, promoting sustainable and conscious consumption behaviors, and sharing

sustainable practices with all consumers, regardless of income level or location, while reducing the carbon footprint created through the production of a traditional human influencer. Ethical governance of Virtual Influencers needs to concentrate on three key areas for sustainability advocacy and messaging: (1) disclosure of whether an influencer is generated by Artificial Intelligence (AI), (2) verifying that sustainability claims made by Virtual Influencers are accurate, and (3) making it illegal to intentionally deceive consumers into believing an influencer is practicing environmentally friendly behavior when in fact they are not. As the development of Virtual Influencer technologies increases in the next few years, regulatory and industry frameworks will be necessary to provide a balance of persuasive influence to consumers with the protection from deceptive marketing and advertising practices that comes with using these technologies. These ideas of what the future holds for Virtual Influencers are consistent with the ethics of persuasion discussed in recent Virtual Influencer research, which indicates that as long as there are transparency and accountability, Virtual Influencers have the potential to be a tool for ethical persuasion driven by Artificial Intelligence (Robinson, 2020; Arsenyan & Mirowska, 2021).

## 5.2 Limitations and Future Research Directions

Although the conceptual framework of the study is informed by the Theory of Planned Behavior, the use of multiple regression analysis limits the ability to test simultaneous mediation effects or complex causal pathways. Future research may extend the present findings by employing structural equation modelling to examine indirect relationships and latent constructs in greater depth. Nevertheless, the regression-based approach adopted in this study is appropriate for its exploratory and prediction-oriented objectives. Although this study had 250 survey participants and 40 interview participants, it is possible that the sample is not representative of the general public. Therefore, the findings may have limited application due to lack of representation of geographical, age, and cultural differences. Participant's opinions and experiences are self-reporting therefore the study is dependent upon participant's reporting of their thoughts/behaviours. Self-reporting can also be bias since participant may report what they think others want to hear (i.e., social desirability) vs. what they actually believe/think/do. This could cause a problem with accuracy of the data, especially when looking at consumers perceptions of sustainability within the fashion industry.

This is another constraint of using multiple regression to analyse data as the method assumes linear relationships among the variables analysed. The complexity of consumer behaviour cannot always be captured by a single, simple line (linear) and therefore this research project will likely miss some of the many ways that the behaviour of consumers can be influenced by many different and inter-related variables. The focus of this research project is on analysing cross-sectional data and as such does not provide a full understanding of how consumer attitudes and/or behaviours are changing or evolving over time. If the project had used a longitudinal approach, it could have

provided an even better insight into these changes and evolution over long-term. Another weakness is the rapid development of virtual influencer technology because digital tools and platforms are changing rapidly. Hence, the findings of the study might become outdated shortly as new technologies emerge, thus reducing their relevance in the future.

Finally, the research focuses only on the involvement and perception of the customers and does not consider other potential such as cultural trends or emotional attachment to a brand. These limitations indicate a deeper understanding of virtual influencers in sustainable fashion require future research with larger and more diverse samples and use of varied methodologies. By adopting a regression-based, theory-informed approach, the study provides empirically grounded insights into virtual influencer effectiveness while maintaining methodological clarity and avoiding analytical over-specification.

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