Emerging Paradigms in Fashion Sustainability: A Comprehensive Exploration of Digital Fashion's Role in Shaping Sustainable Style

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ABSTRACT

The introduction of digital fashion represents a transformative paradigm shift in the realm of style and sustainability. This abstract explores the intersection of technology and fashion, shedding light on how digital innovations are paving the way for a more sustainable industry. (Daria Casciani, 2022) As traditional fashion practices contribute to environmental degradation, the emergence of digital fashion offers a promising alternative by minimizing the ecological footprint associated with physical garment production.

Digital fashion encompasses virtual clothing and accessories that exist solely in the digital realm, challenging conventional notions of materiality and consumption. This abstract delves into the potential of digital fashion to revolutionize the way consumers engage with style, emphasizing the importance of sustainability in an era of heightened environmental consciousness. The paper will examine the environmental benefits of digital fashion, such as reduced waste and energy consumption, and its potential to redefine the fashion industry's approach to design, production, and consumption.

By addressing the opportunities and challenges associated with digital fashion, this research aims to contribute to the ongoing discourse on sustainable style, encouraging a shift towards more eco-friendly and ethical practices within the fashion ecosystem. As the fashion industry grapples with the imperative to minimize its impact on the planet, digital fashion emerges as a promising avenue for fostering a more sustainable and responsible approach to personal expression.

Keywords: Digital Fashion, Sustainability, New Media, Digital Media, Fast Fashion, Influencer market.

INTRODUCTION

In an era dominated by technological advancements, the fashion industry is undergoing a significant transformation. Digital fashion, a ground-breaking concept, has emerged as a beacon of sustainability in an industry often criticized for its environmental impact. This article explores how digital fashion is contributing to

sustainability and reshaping the way we perceive and consume clothing.

The Environmental Toll of Traditional Fashion

Traditional fashion, characterized by mass production, fast fashion, and rapidly changing trends, has long been associated with environmental degradation. The industry is notorious for its excessive use of natural resources, high carbon emissions, and the generation of vast amounts of textile waste. From water-intensive cotton cultivation to chemical-laden dyeing processes, the environmental toll of conventional fashion practices is staggering. (Kirsi Niinimaki, 2020)

Digital Fashion: A Sustainable Alternative

Digital fashion offers a sustainable alternative by reducing the demand for physical garments and minimizing the environmental impact associated with traditional fashion. This innovative concept involves the creation of virtual clothing items that exist solely in the digital realm. Digital fashion is not confined to video games and virtual reality; it is increasingly making its mark in the real world through augmented reality (AR) and non-fungible tokens (NFTs).

Reducing Fashion's Carbon Footprint

One of the primary contributors to the carbon footprint of the fashion industry is the production and transportation of physical garments. Digital fashion mitigates this impact by eliminating the need for raw materials, manufacturing, and shipping. (Walter leal, 2022) Designers can create unique and imaginative pieces without the constraints of physical limitations, and consumers can enjoy a diverse wardrobe without contributing to the carbon-intensive life cycle of traditional clothing.

Fostering Circular Fashion Economy

Digital fashion aligns seamlessly with the principles of a circular fashion economy, emphasizing sustainability and waste reduction. In the digital realm, garments can be easily recycled, repurposed, or modified without generating physical waste. This contrasts sharply with the traditional fashion industry, where discarded clothing contributes to the mounting issue of textile waste in landfills. (Fransen, 2023) (Jacometti, 2019)

Personalization and Endless Creativity

Digital fashion empowers consumers to express their individuality by enabling personalization and customization. Through virtual platforms, users can design their digital wardrobe, experimenting with styles and combinations without the need for physical production. (Akash Takyar, 2023)This not only reduces the consumption of tangible resources but also fosters a more conscious and deliberate approach to fashion.

Economic Benefits and Ethical Considerations

Beyond environmental advantages, digital fashion presents economic benefits and ethical considerations. Designers can reach a global audience without the need for extensive manufacturing and distribution processes. Furthermore, digital fashion challenges the traditional norms of labour-intensive production, offering an opportunity to explore ethical and sustainable practices in the creative industry. (Hicks, 2018)

The Role of Social Media and Virtual Platforms

The rise of new media—particularly social media platforms like Instagram and TikTok, as well as virtual spaces such as Decentraland and The Sandbox—has played a key role in the growth of digital fashion. These platforms offer a space where virtual clothing can be showcased and traded, allowing consumers to interact with fashion in entirely new ways. For example, virtual clothing can be used for online avatars, creating a growing market for digital fashion (Cunningham & McKinley, 2022).

Influencers have also played a significant role in driving the popularity of digital fashion. Many influencers now showcase virtual outfits on their social media profiles, often promoting them as eco-friendly alternatives to traditional fashion. By embracing digital garments, influencers are helping to spread the idea that sustainable fashion doesn't always have to involve physical clothing. This shift is significant in a time when sustainability has become a key concern for younger consumers, who are particularly attuned to issues like climate change and waste (Norris, 2022).

Digital Fashion and the Fast Fashion Industry

The rise of digital fashion also presents an alternative to the traditional fast fashion model. Fast fashion relies on mass production and quick turnover, which contributes to high levels of waste and unethical labour practices. Digital fashion has the potential to disrupt this model by offering virtual alternatives to the constant cycle of production and consumption. Instead of purchasing new physical items, consumers can buy and wear virtual clothing, which requires no raw materials or manufacturing processes (Fletcher, 2021).

However, it's important to recognize that the rise of digital fashion doesn't automatically mean that sustainable behaviour will follow. As digital platforms continue to grow, the psychological and emotional impact of digital fashion remains an important consideration. Consumers often associate clothing with personal identity and self-expression, and virtual clothing may not fully replicate the experience of wearing physical garments. This could limit the appeal of digital fashion for some consumers who still value the tactile, physical experience of clothing (McKinsey & Company, 2020).

Digital Fashion Platforms Analysis

The research will involve a detailed examination of digital fashion platforms, employing content analysis and usability testing. This analysis will assess the platform's environmental policies, transparency in the supply chain, and the extent to which sustainable design principles are incorporated. User experience evaluations will also be conducted to understand the platform's influence on consumer engagement and purchasing decisions.

LITERATURE REVIEW

The fashion industry has long been associated with significant environmental issues, including pollution, waste, and high resource consumption. As concerns about the industry's environmental impact grow, there is increasing interest in sustainable alternatives. One of the most promising innovations is digital fashion, virtual clothing and accessories that exist only in digital spaces. This literature review explores how digital fashion is changing the way we think about sustainability in fashion. By offering a digital-only alternative, it has the potential to reduce waste, energy use, and the environmental footprint of traditional fashion practices.

Digital fashion offers a unique solution to some of the fashion industry's biggest environmental problems. Traditional fashion production involves the extraction of raw materials, garment manufacturing, and transportation, all of which contribute to high levels of carbon emissions and waste. According to the Ellen MacArthur Foundation, the global fashion industry is responsible for about 10% of carbon emissions worldwide, more than the combined emissions of aviation and shipping (Ellen MacArthur Foundation, 2017).

Digital fashion eliminates the need for physical garments. Instead, consumers can buy virtual clothing for use in online environments such as social media, virtual reality platforms, and video games. This reduces the environmental impact of textile production and waste, as no physical materials are involved. Moreover, because digital clothing can be updated or reused in different virtual environments, it can help reduce the need for constant new production, encouraging a more sustainable approach to personal style (McKinsey & Company, 2020).

Despite its potential, digital fashion is not without challenges. One major issue is the energy consumption required to support the digital infrastructure behind virtual fashion. Many virtual worlds and blockchain-based fashion items, such as NFTs (non-fungible tokens), are powered by energy-intensive systems. For example, blockchain networks like Ethereum, which are used to mint NFTs, require large amounts of computing power, resulting in substantial energy usage. This raises concerns about whether digital fashion is truly sustainable when considering the environmental costs of running these platforms (Rizzo & Kennedy, 2023).

Moreover, there is the question of accessibility. While digital fashion offers a more sustainable alternative, it relies on access to technology and digital literacy. Not everyone has access to the devices or the internet required to participate in digital fashion markets. As digital fashion grows, it will be important to ensure that it remains accessible to diverse groups of consumers and doesn't exacerbate existing inequalities (Stevenson, 2021).

One of the key benefits of digital fashion is its ability to change consumer behaviour. Virtual clothing allows consumers to experiment with their style in ways that physical clothing cannot. For example, consumers can buy digital garments for their avatars in online games or on social media without the need to invest in new physical clothing. This shift challenges traditional ideas of fashion ownership and instead promotes access over possession (Fletcher & Tham, 2021).

Additionally, digital fashion can encourage more mindful consumption by reducing the pressure to constantly buy new clothes. As more people engage with digital fashion, the emphasis may shift from owning a large number of garments to curating a smaller, more meaningful virtual wardrobe. This could ultimately reduce the environmental impact of fashion by promoting a more conscious and thoughtful approach to personal style.

Digital fashion represents a promising step toward a more sustainable future for the fashion industry. By offering a way to enjoy style without the environmental costs of physical garment production, digital fashion has the potential to reshape how we think about consumption and personal expression. However, challenges remain, particularly in terms of energy usage and accessibility. To ensure that digital fashion truly offers a sustainable alternative, it will be important to continue exploring how digital platforms can reduce their environmental impact while also being inclusive to a wider range of consumers.

In summary, while digital fashion is not a perfect solution, it represents an exciting opportunity to rethink the fashion industry's environmental impact and move toward a more sustainable, digital-first future.

Research Problem

The rise of digital fashion presents an exciting opportunity to reduce the environmental impact of the fashion industry, particularly in terms of material waste, carbon emissions, and the overproduction of garments. Digital fashion—virtual clothing that exists only in digital spaces—has been hailed as a potential solution to the unsustainable practices associated with traditional fashion production, including the resource-intensive processes of textile manufacturing and the constant churn of fast fashion. However, despite its promising benefits, digital fashion remains an emerging

concept with both significant potential and complex challenges that need to be addressed.

Theoretical Framework

i. Circular Economy Theory

Circular Economy Theory is highly relevant because digital fashion can potentially be seen as a part of a more sustainable, circular model of fashion consumption. The circular economy is focused on reducing waste, extending product lifecycles, and using resources more efficiently by encouraging practices like reuse, repair, and recycling. Digital fashion offers a clear example of how a product (in this case, clothing) can be reused infinitely without generating physical waste. Since digital garments are intangible and do not require raw materials, they do not contribute to resource extraction, textile production, or garment waste.

By applying circular economy theory, you could explore how digital fashion enables a closed-loop system in the fashion industry, where virtual garments can be reused and reimagined for different purposes, without the environmental costs typically associated with traditional clothing production (e.g., manufacturing, transportation, landfill waste). This would help assess whether digital fashion can reduce the industry's reliance on linear consumption (take, make, dispose) and create a more sustainable and resource-efficient fashion system[1].

ii. Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) is a foundational theory in understanding how new technologies are adopted by users. This model suggests that the perceived ease of use and perceived usefulness of a technology are the two key factors that influence user acceptance. In the case of digital fashion, TAM can help explore how consumers perceive digital clothing platforms and whether they see them as a viable alternative to traditional clothing.

Digital fashion technologies, which involve virtual clothing, augmented reality (AR), and blockchain (NFTs), may require a shift in consumers' behaviour and perceptions. If users find these technologies easy to navigate and useful in expressing their identity (via avatars, gaming, or social media), they are more likely to adopt them. By applying TAM, your research could explore the factors that encourage or hinder consumers' willingness to adopt virtual clothing and how digital fashion could become more mainstream as an environmentally sustainable choice[2].

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[1] Bocken, N.M.P., Short, S.W., Rana, P., & Evans, S. (2014). A Literature and Practice Review to Develop Sustainable Business Model Archetypes. *Journal of Cleaner Production*, 65, 42-56.

[2] Davis, F.D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, 13(3), 319-340.

METHODOLOGY

The researcher examined different types of digital content, including website data, product descriptions, social media posts, and multimedia elements, and used qualitative keyword techniques to study them systematically. The goal was to identify common themes, patterns, and trends related to sustainability practices based on specific criteria that had been set.

Usability testing was conducted to understand how users interacted with these platforms, especially regarding sustainability features and their influence on user engagement and purchasing decisions. The target audience was youngsters aged 19 to 25 years who spent more than two hours daily on digital media and had a good understanding of fashion. Data on 80 variables were collected. The study's scope included PAN India fashion studies students from the National Institute of Fashion Technology with at least one active social media account.

Insights were gathered through methods like think-aloud protocols, interviews, and observations to better understand user behaviours. The researcher collected data through in-depth one-on-one interviews and focus group discussions. By combining findings from content analysis and user experience evaluations, the study provided a clear understanding of how digital fashion platforms approached sustainability and how it impacted consumer behaviour online.

Findings and Discussion: Sustainability in Digital Fashion Platforms

This research explores the sustainability practices of digital fashion platforms and how these practices influence consumer behaviour among young adults (ages 19 to 25) from fashion studies backgrounds in India. Through a combination of content analysis, usability testing, and qualitative data from interviews and focus group discussions, the study provides a nuanced view of how digital platforms in fashion are engaging with sustainability. Brands analysed include Zara, H&M, ASOS, Boohoo, FabIndia, and Vistara. The following findings highlight key insights derived from both digital media analysis and usability testing.

i.   Digital Fashion Platforms: Sustainability Practices

The content analysis focused on the sustainability practices and ethical standards of major digital fashion brands. The researcher identified several common themes related to sustainability through the analysis of brand messaging on their websites, social media, and other digital media channels.
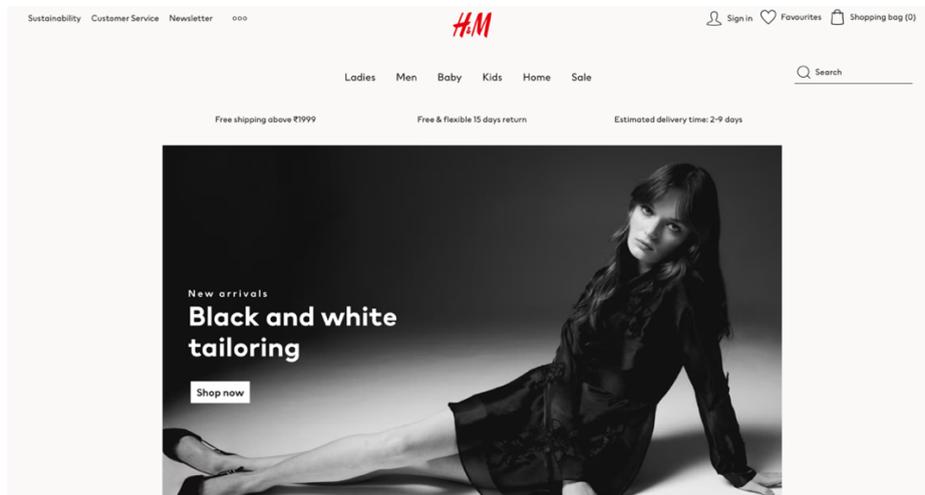
H&M

Fig- 01 retrieved from https://www2.hm.com/en_in/index.html

H&M has actively worked towards sustainability by incorporating recycled fabrics and organic cotton into its product range, notably through its Conscious Collection, which encourages eco-friendly fashion. The brand has also launched initiatives like garment recycling programs to promote circular practices. However, despite these efforts, concerns about poor labor conditions in its supply chain have persisted. In response, H&M has sought to improve transparency and partnered with labor organizations to address these issues. While the brand highlights its use of sustainable materials and its commitment to the circular economy, some consumers remain skeptical, citing concerns about greenwashing in its sustainability claims.
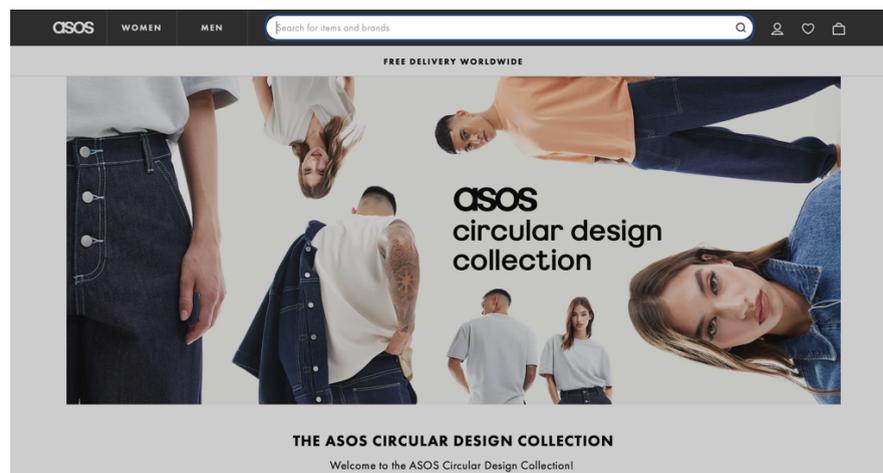
ASOS

Fig- 02 retrieved from https://www.asos.com/women/a-to-z-of-brands/asos-design/cat/?cid=27869&ctaref=hp|generic|feature|9|wwbrand3

ASOS has introduced its Responsible Edit to highlight products made with sustainable materials and ethically sourced fabrics, reinforcing its commitment to eco-conscious

fashion. The company aims to enhance supply chain transparency and work toward carbon neutrality. Although ASOS collaborates with organizations like Fair Trade, critics argue that its sustainability initiatives fall short, particularly given its reliance on the fast-fashion model. Consumers often associate ASOS with terms such as eco-friendly, carbon neutral, fair trade, sustainability goals, transparency, and fast fashion, reflecting both its efforts and the challenges it faces in aligning with truly sustainable practices.
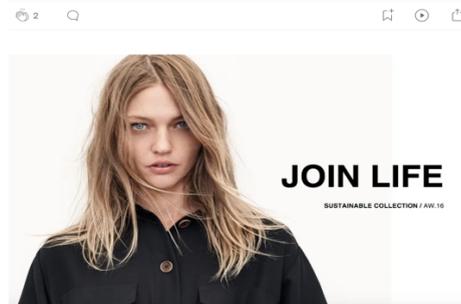
Zara

Fig- 03 retrieved from *https://medium.com/@sumraiqbal/how-ethical-is-zaras-join-life-collection-4173a92e069d*

Zara, part of the Inditex Group, has introduced its Join Life program, focusing on eco-friendly materials and efficient production processes to promote sustainability. Despite these efforts, the brand has been criticized for producing large quantities of clothing, which contributes to waste, a common issue in fast fashion. To address this, Zara has launched programs to recycle used garments. Words often linked with Zara in discussions include Join Life, sustainable materials, eco-efficient, overproduction, and circular economy, reflecting both its sustainability efforts and the challenges it faces in reducing environmental impact.
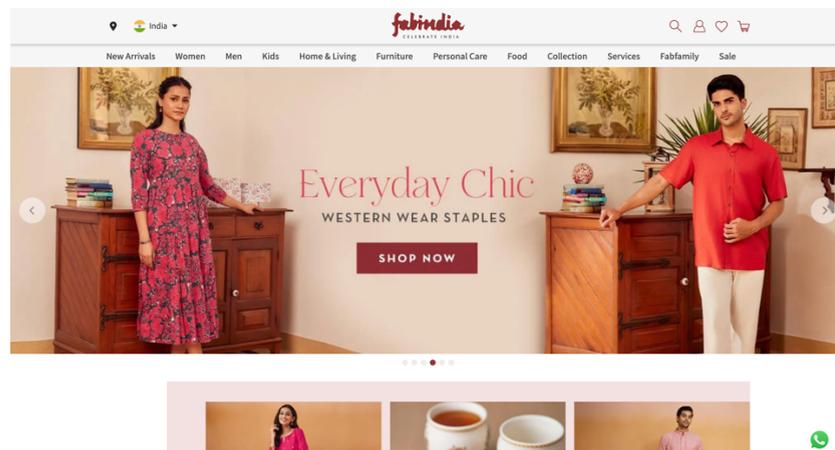
Fab India

Fig- 04 retrieved from
https://www.fabindia.com/?gad_source=1&gbraid=0AAAAADnN-

FabIndia focuses on traditional, handcrafted textiles and supports local artisans. It uses sustainable materials and promotes slow fashion through its handmade and eco-friendly products. FabIndia promotes fair wages and local empowerment, making it one of the more ethical fashion brands in India. After Analysis keywords found - Handcrafted, Fair Trade, Empowerment, and Sustainable Practices.
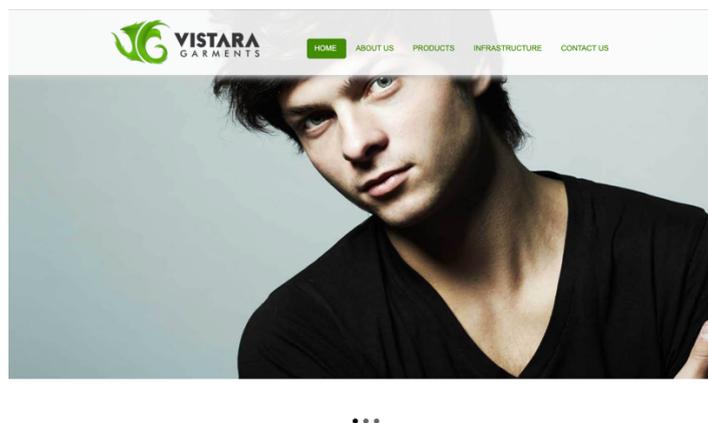
Vistara

Fig- 05 retrieved from http://www.vistaragarments.com

While Vistara is primarily a fashion and lifestyle brand, it has introduced eco-friendly packaging and supports sustainable consumption. Vistara's ethical presence is not as prominent in terms of transparency compared to others in this study, as its fashion items tend to focus on more niche markets with limited data available on their sustainability practices. Eco-friendly, Niche Market, and Sustainable Consumption are the keywords which were found at the time of analysis.

ii. User Experience & Usability Testing

The usability testing, which involved interviews and focus group discussions, provided valuable insights into how young consumers interact with digital platforms, particularly regarding sustainability.

Virtual Try-Ons and AR Technology:

100% respondents discussed platforms like ASOS and Zara featured augmented reality (AR) technology that allowed users to try on digital clothing. Users appreciated the convenience of AR but desired more realistic fabric simulations and better fitting accuracy. Some participants noted that the sustainability messaging embedded within these tools was underemphasized and difficult to locate during the shopping experience.

Sustainability Features and Messaging:

According to 88% While brands like H&M and Zara had clear sustainability messages on their websites, the majority of participants expressed that these claims were often too generic or difficult to verify. For example, sustainability messages often appeared under sections like Product Care or Our Values, which users did not prioritize. This shows a clear gap in information accessibility.

Impact on Purchase Decisions:

During interviews, more than 80% participants indicated that they would consider sustainability a secondary factor in their decision to purchase, with style, price, and convenience taking priority. However, sustainability features did influence them if it was clear and easily accessible, particularly when information was integrated into product pages, like H&M's Conscious Collection or ASOS's Responsible Edit.

Keywords from Digital Media Analysis and Usability Testing

The findings from digital media analysis and usability testing emphasize three interconnected areas: sustainability, technology, and consumer behaviour. In sustainability, terms like eco-friendly, sustainable materials, fair trade, and carbon neutral underline the industry's focus on environmentally responsible practices. From a technological standpoint, advancements such as virtual try-ons, augmented reality (AR), and fabric simulation are transforming how consumers interact with digital fashion. Consumer preferences reflect an emphasis on transparency, convenience, and style, alongside growing attention to ethical values. This integration highlights how sustainability and technology are reshaping consumer expectations and the overall landscape of fashion.

Similarities Between Digital Media Analysis and Usability Testing:

- Sustainability Messaging: Both the digital media analysis and usability testing highlight that sustainability messaging is present but often not emphasised enough in the user experience. Users felt that more transparency and clear

communication about environmental and ethical practices could motivate them to make more sustainable choices.

- Technology-Driven Features: The virtual try-on and AR technology were a highlight across both platforms and user interactions. However, users desired better realistic fabric representation and a stronger link between virtual garments and sustainability messaging. This shows the need for brands to integrate sustainability more effectively into their technological features.

Life Cycle Assessment (LCA) and Environmental Impact

The LCA of digital fashion revealed that while digital fashion itself (e.g., virtual clothing, digital garment design) consumes far fewer resources compared to traditional fashion, there are still environmental impacts associated with data storage and server operations. Platforms like ASOS and Zara, which heavily rely on digital infrastructure, still have carbon footprints from their server farms. On the other hand, brands like FabIndia, which focus on sustainable material sourcing and artisan empowerment, are likely to have a lower environmental footprint overall.

CONCLUSION

This study's findings both support and challenge existing theories about the potential of digital fashion for sustainability.

Theory of Digital Fashion as a Sustainable Alternative: While digital fashion is theoretically more sustainable due to the reduced need for physical production, transportation, and waste, the findings show that consumer adoption is still low. Users prioritize style, price, and convenience, and do not perceive digital fashion as a fully developed substitute for physical garments.

Scepticism Around Sustainability Claims: Brands like H&M and ASOS promote sustainability, but the study's data suggests that greenwashing remains a concern. Many young consumers doubt the actual impact of sustainability claims unless clear evidence and traceable data are provided.

Consumer-Driven Innovation: The study shows that the technology-driven features like AR and virtual try-ons are appreciated, but the integration of sustainability needs improvement. Brands must focus on user-centric innovations that seamlessly combine digital experiences with sustainable fashion practices.

In conclusion, while digital fashion presents a promising alternative to traditional fashion, its true potential for sustainability will depend on clearer, more transparent communication of ethical practices and technological innovations that integrate sustainability into every aspect of the user experience. Brands must be more proactive in adopting genuine sustainability practices and ensuring that these practices are not

just superficial claims but part of a holistic, verifiable effort.

LIMITATION

This research has certain limitations. It primarily examines young consumers aged 19–25 from India, which restricts the applicability of the findings to a broader audience. The reliance on qualitative methods provides valuable insights but lacks the precision of quantitative analysis. Moreover, the environmental impact of digital infrastructure, such as blockchain technology and server usage, is not fully explored. Additionally, the dynamic nature of digital fashion and difficulties in validating sustainability claims may affect the long-term accuracy and relevance of the results.

REFERENCES

Neil Charness, W. R., 2016. *Science direct.com.* [Online]
Available at: https://www.sciencedirect.com/topics/social-sciences/technology-acceptance-model
[Accessed 2023].

Halton, C., 2023. *Investopedia.com.* [Online]
Available at: https://www.investopedia.com/terms/d/diffusion-of-innovations-theory.asp

Michael Jonas, B. L. i., 2015. *Science Direct.* [Online]
Available at: https://www.sciencedirect.com/topics/social-sciences/sustainable-consumption#:~:text=Conceptual%20work%20in%20the%20area,empirical%20studies%2C%20and%20vice%20versa.
[Accessed 2023].

Morgado, M., 2016. [Online] Available at:
https://www.researchgate.net/publication/265211939_Fashion_phenomena_and_the_post-postmodern_condition_Enquiry_and_speculation
Kirsi Niinimaki, G. P. E. D., 2020. The environmental price of fast fashion. *Research Gate,* April.

Fransen, B., 2023. *Eco Matcher.* [Online]
Available at: https://www.ecomatcher.com/the-circular-fashion-economy-a-sustainable-shift-towards-a-greener-future/

Jacometti, V., 2019. *mdpi.com.* [Online]
Available at: https://www.mdpi.com/2075-471X/8/4/27
[Accessed 10 2019].

Hicks, S. R., 2018. *Ethics and Economics* , Washington, D.C.: s.n.

Meng, X., 2022. Application of Digital Technology to the Construction of the Fashion Design System under Mass Customization Mode. *Mathematical Problems in Engineering · 2022(4):1-8,* June.

Daria Casciani, O. C. &. R. P., 2022. Exploring the nature of digital transformation in the fashion industry: opportunities for supply chains, business models, and sustainability- oriented innovations. *Sustainability: Science, Practice and Policy,* 18 10, 18(2022), pp. 773-795.

Akash Takyar, 2023. *AI for fashion brands: Use cases, benefits and future trends in the fashion landscape.* [Online]
Available at: https://www.leewayhertz.com/ai-use-cases-in-fashion/

Anika Kozlowski, M. B., 2012. *Environmental impacts in the fashion industry: a life-cycle and stakeholder framework.* [Online]
Available at:
https://www.researchgate.net/publication/260979899_Environmental_impacts_ in_the_fashion_industry_a_life-cycle_and_stakeholder_framework

Walter leal, P. P. H. H., 2022. An overview of the contribution of the textiles sector to climate change. *Sec. Toxicology, Pollution and the Environment,* 05 09.Volume 10.

Cunningham, S., & McKinley, E. (2022). *The Rise of Digital Fashion: Virtual Clothing as a New Form of Self-Expression*. Journal of Fashion and Technology, 9(2), 45-60.

Ellen MacArthur Foundation. (2017). *A New Textiles Economy: Redesigning Fashion's Future*. Retrieved from https://www.ellenmacarthurfoundation.org

Fletcher, K. (2021). *Sustainable Fashion and Digital Innovation: A New Era for the Industry*. Fashion Theory, 25(4), 512-529.

Fletcher, K., & Tham, M. (2021). *Fashion and Sustainability: Design for Change*. Routledge.

McKinsey & Company. (2020). *The State of Fashion 2020: Navigating the New Luxury Landscape*. McKinsey & Company.

Norris, L. (2022). *Fashion Influencers and the Digital Revolution: Impact on Sustainability*. Journal of Fashion Sustainability, 3(1), 30-42.

Rizzo, M., & Kennedy, M. (2023). *The Environmental Impact of NFTs in Fashion: A*

Critical Analysis. Digital Sustainability Journal, 12(3), 177-193.

Stevenson, S. (2021). *Digital Fashion: Accessibility and Equity in the Virtual World*. Journal of Fashion Technology and Sustainability, 18(1), 59-75.

Vogue Business. (2021). *The Digital Fashion Revolution: Market Growth and Consumer Engagement*. Retrieved from https://www.voguebusiness.com