**The Transformative Role of Augmented Reality (AR) and Virtual Reality (VR) in E-commerce and Digital Marketing: Enhancing Consumer Engagement and Trust**

# Abstract

This review examines the transformative role of Augmented Reality (AR) and Virtual Reality (VR) technologies in e-commerce and digital marketing. AR and VR provide immersive and interactive experiences, bridging the gap between traditional in-store and online shopping by enabling consumers to visualize and interact with products virtually. The integration of these technologies addresses critical challenges in online retail, such as product visualization, consumer trust, and engagement. AR facilitates real-time, contextual interactions, such as virtual try-ons and spatial placements, while VR creates fully immersive environments replicating or enhancing physical shopping experiences. The paper synthesizes current research, exploring the impact of AR and VR on consumer behavior, customer brand engagement, and purchase intentions. Additionally, it discusses the potential of these technologies to drive higher conversion rates, reduce return rates, and foster personalized shopping experiences. Despite their promise, challenges such as cost, accessibility, and technical limitations remain. This review highlights the need for strategic implementation and further research to maximize the benefits of AR and VR in reshaping the digital marketing and e-commerce landscape.

**Keywords**: Augmented Reality (AR), Virtual Reality (VR), E-commerce Innovation, Digital Marketing, Customer Engagement, 3D Product Visualization, Immersive Shopping Experience

# Introduction

These global players shape the market by driving innovation, expanding product offerings, and tapping into new consumer demographics. The industry's rapid growth is further fueled by trends such as sustainability, ethical production practices, and the increasing demand for personalized beauty products. With a growing emphasis on digital marketing, social media influence, and influencer collaborations, the cosmetic industry continues to thrive in a highly competitive and dynamic global market.[1] The rapid advancements in technology over recent decades have dramatically transformed everyday life, particularly in the realm of retail. E- commerce has surged as a dominant force, shifting consumer shopping behavior from brick-and- mortar stores to online platforms. As of recent reports, 43% of shopping activities are now conducted exclusively online, reflecting the ongoing growth of e-commerce, which was valued at

$2.3 trillion globally in 2017 and is projected to double by 2022. However, despite the convenience and growth of online shopping, it often lacks the emotional engagement and immersive experiences that physical stores offer. Augmented Reality (AR) and Virtual Reality (VR) have emerged as potential solutions, allowing for richer, more interactive online shopping experiences. These technologies enable consumers to engage with products in a more personal and dynamic way, which could help bridge the gap between expectations and actual product experiences, potentially reducing issues such as high return rates. This study aims to explore the impact of 3D product visualizations in e-commerce on consumer shopping experiences, focusing on how these technologies might revolutionize online retail by enhancing sensory engagement and emotional connection. [2] Augmented Reality (AR) is a powerful perception strategy that enhances the real world by overlaying computer-generated graphics. It has broad applications, including e-commerce, where it can significantly improve customer experiences. AR enables consumers to visualize products and interact with virtual elements as if they were part of the physical environment. This technology addresses the "try before you buy" challenge, offering a more immersive shopping experience, especially in online settings where users are increasingly seeking realistic visual and material simulations. E-commerce businesses are incorporating rich media content, such as high-resolution images, videos, and 3D designs, to enhance online shopping. AR is particularly promising in creating dynamic and engaging interfaces that provide customers with an enhanced, more interactive experience. Despite its potential, the adoption of AR in e-commerce remains limited, with companies still exploring how best to leverage this technology to improve consumer interaction and drive sales. [3] The integration of Virtual Reality (VR) and Augmented Reality (AR) has revolutionized e-commerce, reshaping how consumers interact with online shopping platforms. In recent years, VR and AR have gained immense attention, especially after significant investments from companies like Mark Zuckerberg’s purchase of Oculus for $2 billion. Industry giants such as Sony, Samsung, HTC, and Google are heavily investing in these technologies, which initially emerged in computer graphics but have expanded into various fields. VR creates immersive environments by engaging the senses, while AR merges digital objects with the real world, as seen in games like Pokémon Go. These innovations address key challenges in e-commerce, such as building consumer trust and enhancing product visualization [25,26]. By 2030, VR and AR are expected to contribute an additional $1.5 trillion to the global economy, with brands using these technologies to engage and inspire consumers in unprecedented ways, like Samsung’s virtual moonwalk or Oreo’s

immersive experience of its new product. [4] Advances in technologies like augmented reality (AR), virtual reality (VR), the Internet of Things (IoT), and artificial intelligence (AI) are revolutionizing marketing. AR, in particular, is gaining significant traction in digital marketing. This technology overlays digital content—such as images, videos, text, and audio—onto real- world environments using devices like smartphones and tablets. With the rise of mobile AR apps, businesses are leveraging AR to offer unique, interactive experiences that engage customers, influence purchasing decisions, and enhance brand loyalty. AR's use in retail allows consumers to try products virtually before buying, improving their shopping experience and increasing sales. Brands like Ray-Ban and Sephora are already incorporating AR into their strategies. As customer engagement becomes increasingly important, AR provides a powerful tool to foster deeper emotional connections and promote brand awareness. The technology's potential to drive customer brand engagement (CBE) highlights its value in shaping modern marketing approaches. This study will explore how AR influences CBE and the factors that make AR an effective marketing tool [5]. Virtual reality (VR) is revolutionizing various industries by creating immersive experiences through pose tracking and 3D displays. Beyond gaming, VR is transforming sectors like business, education, and entertainment, offering applications such as training simulations and enhanced customer interactions. With the rise of extended reality (XR), which includes augmented and mixed reality, the lines between digital and physical worlds are becoming increasingly blurred. In e-commerce, VR is helping businesses replicate real-world shopping experiences, bridging the gap between online and in-store retail. This paper explores how VR impacts consumer behavior, retail experiences, and the broader shopping journey, highlighting its potential to enhance customer engagement and transform business strategies. Through qualitative research, including interviews with industry professionals and users, the study reveals that while VR offers exciting opportunities, companies must adopt well-planned strategies to fully leverage its potential.[6] Augmented reality (AR) is a technology that overlays digital content onto the physical world, creating an interface between the two realms (Javornik, 2016b; Porter & Heppelmann, 2017; Yim, Chu, & Sauer, 2017). In retail, AR enhances the shopping experience by allowing customers to visualize how products will look in their environment or on themselves, eliminating the need for imagination (Heller et al., 2019a; Hilken et al., 2017; Verhagen et al., 2014). This technology not only reduces travel and shopping time but also aids in translating two-dimensional information into a three- dimensional context, which aligns with consumers' natural information-processing abilities (Hilken et al., 2017; Porter & Heppelmann, 2017). Ultimately, AR can improve decision-making, accelerate information assimilation, and elevate the overall shopping experience (Dacko, 2017; Huang & Liao, 2015).[7] Augmented Reality (AR) is increasingly integrated into digital marketing strategies by retailers, alongside Virtual Reality (VR) as part of Extended Reality (XR) technology. AR enhances the customer experience by blending virtual elements, like 3D models or text, with the real world. This interaction allows customers to control product features (size, rotation, position), making it easier to visualize items in real-life settings, such as furniture in their homes. AR is accessible via smartphones and tablets, making it a convenient tool for retailers like IKEA, Sephora, and Starbucks to support pre-purchase decision-making. The use of AR is growing rapidly, with over 1 billion users expected by 2024. This growth parallels the rise in smartphone usage, offering brands a valuable opportunity to boost sales through AR apps.

Research has shown that AR apps positively influence consumer behavior, such as increased purchase intent, loyalty, and social sharing. Word-of-mouth (WOM) plays a crucial role in this, as customers are likely to share their positive AR experiences, amplifying the product's reach. However, there is limited research on the psychological effects of AR features on consumer behavior, particularly regarding WOM intention. This study aims to explore how AR features influence customer emotions (pleasure and arousal) and whether these emotions mediate the relationship between AR app features and WOM intention, offering insights for marketers.[8] Augmented Reality (AR) and Virtual Reality (VR) are transforming the e-commerce landscape by offering innovative solutions to long-standing challenges in online retail. These technologies provide immersive, interactive, and personalized shopping experiences, reshaping how consumers interact with products and making online shopping more engaging. AR allows users to virtually try products and visualize them in real life, while VR immerses them in simulated environments, offering a deeper exploration of products. Together, they bridge the gap between traditional shopping and e-commerce, enhancing customer satisfaction and reducing uncertainties. This literature review explores the profound impact of AR and VR on consumer behavior, e-commerce businesses, and the competitive dynamics of the industry [9]. In 2020, E- commerce saw a major boost, with companies like Walmart and Amazon driving a 42% increase in online sales, totaling $4.06 trillion. Despite this growth, cart abandonment remains a challenge, with 77.3% of shoppers leaving without completing purchases. Augmented reality (AR) offers a solution by allowing consumers to virtually try products, improving decision-making and boosting confidence. As the AR market expands, E-commerce businesses adopting this technology can expect higher conversion rates and a competitive edge [10]. E-commerce has transformed business practices, enabling global reach, cost reduction, and higher returns. With the rise of the internet, businesses are using new technologies like Augmented Reality (AR) to enhance customer experiences. AR blends the physical world with digital content, offering immersive, interactive experiences. This technology improves product visualization, marketing, and customer engagement. By leveraging AR, businesses can create innovative ways for consumers to explore products, revolutionizing the shopping experience and unlocking new opportunities in the digital age.[11].

# Theoretical Backgrounds

To achieve a stronger emotionally engaging experience in e-commerce and thus a higher consumer engagement, 3D product visualizations via AR and VR received increasing attention from retailers in recent years (Sihi, 2018). However, caution is required as an inadequate integration of a visualization type may negatively influence consumers’ brand perception and the brand success in the long run (Y. Liu et al., 2020; Su et al., 2020). Therefore, this chapter focuses on both the theoretical contributions and practical implementations of AR and VR 3D product visualizations in e-commerce compared to the widespread 2D product images.

# E-commerce

The first electronic retail transaction on August 11, 1994, not only introduced the term e- commerce but also revolutionized shopping habits (Jaller & Pahwa, 2020). E-commerce allows businesses to offer personalized experiences by understanding customer preferences, providing the right products at the right time, and expanding their reach globally (Elboudali et al., 2020; Paz & Delgado, 2020). This flexibility and convenience are key drivers for e-commerce's rapid

growth, with positive feedback and continued expansion forecasted (Klaus, 2020; Jaller & Pahwa, 2020). Despite its success, e-commerce still faces challenges in replicating the sensory experiences of physical stores, particularly in terms of product visualization (Paz & Delgado, 2020). Most online retailers use static 2D images, which limit the sensory engagement that consumers experience in brick-and-mortar stores (Elboudali et al., 2020; K. H. Liu et al., 2020). 3D visualizations could enhance this experience by providing more detailed and interactive product information (Jessen et al., 2020; Y. Liu et al., 2020), allowing consumers to engage more deeply with the products they are considering (Haile & Kang, 2020). However, while 3D technology offers a solution to this gap, it must be implemented carefully to avoid overwhelming users (Do et al., 2020; Sihi, 2018). The success of these innovations depends on creating an engaging yet manageable shopping experience (Jang et al., 2019). Given the growing expectations for e-commerce to surpass brick-and-mortar experiences, the challenge lies in how to integrate these features effectively (Xue et al., 2020; Klaus, 2020).

# 3D product visualizations

Technological developments like AR and VR have recently become a focus for retailers in e- commerce, despite being used in other business areas for years (Rauschnabel, 2018; Romano et al., 2020; Sung, 2021; Xue et al., 2020). This shift is driven by four key factors: 1) AR and VR help retailers differentiate from competitors (Sihi, 2018), 2) differentiation attracts more consumers in a competitive market (Sihi, 2018), 3) these technologies provide richer product information, reducing purchase risks and returns (Jessen et al., 2020; Lee & Xu, 2018; Liu et al., 2020; Sihi, 2018; Veneruso et al., 2020), and 4) they enhance the overall online shopping experience (Sihi, 2018).

# Augmented reality

As stated by Y. Liu et al. (2020), Augmented Reality (AR) overlays computer-generated 3D objects onto a real-world environment. Dacko (2017) builds on Azuma's (1997) theory, emphasizing three key pillars of AR: 1) combining virtual and real objects, 2) real-time interaction, and 3) perceiving virtual objects in a real setting. AR is also referred to as "mixed reality" due to the coexistence of virtual and real elements (Dacko, 2017; Do et al., 2020). In retail, AR enhances the shopping experience by providing 3D product visualizations via stationary devices, enriching consumer engagement (Dacko, 2017; Park & Kim, 2021). In e- commerce, AR utilizes camera-equipped mobile devices and retailer apps for realistic 3D product displays (Haile & Kang, 2020; Y. Liu et al., 2020). Though AR has existed since the 1960s, it became more widespread in the early 2000s, offering retailers an opportunity for market differentiation (Do et al., 2020; Jessen et al., 2020). AR applications include environment augmentation, as shown in Figure 1.



*Figure 1. Environment-augmentation (Ar-Ty., 2017*

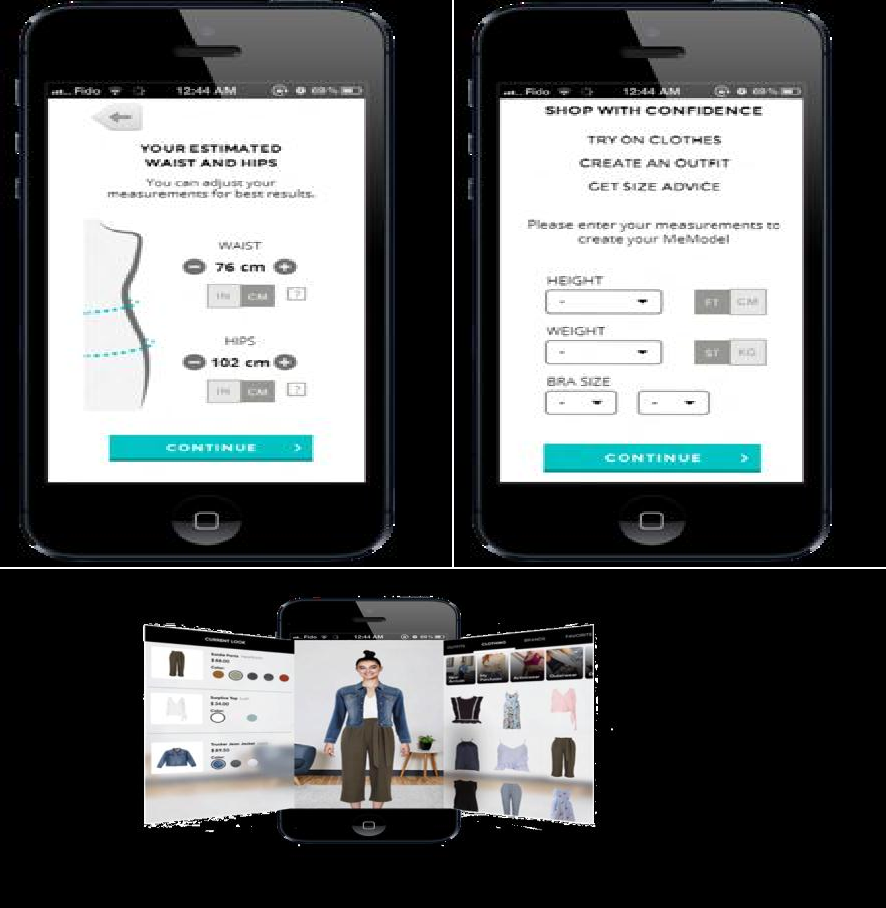
Augmented Reality (AR) in e-commerce enables customers to virtually try products (like furniture or clothing) in their real-world environment or on their own body. This "virtual try-on" or "magic mirror" technology reduces e-commerce's main drawback—uncertainty—by providing a more realistic shopping experience. AR helps visualize product fit and appearance, offering both utilitarian and hedonic benefits, and encourages consumer engagement. However, AR can be intrusive if overly interactive, leading to cognitive overload. Challenges include privacy concerns, especially regarding camera access, and the quality of virtual try-ons, particularly for clothing. Despite these issues, AR enhances the shopping experience by allowing consumers to interact with products in real-time, though there's a risk it may be used more for entertainment than for transactions.



*Figure 2. Self-augmentation (Grigonis., 2020)*

# Virtual reality

Contrary to AR, VR, developed in 1980, immerses users in a synthetic virtual world, allowing real-time interaction with computer-generated 3D objects and others via avatars (Cowan & Ketron, 2019; Haile & Kang, 2020). In e-commerce, VR creates a simulated shopping experience that feels equivalent to brick-and-mortar stores (Y. Liu et al., 2020). Two main VR applications in online retail are virtual fitting rooms (VFR), where consumers try on garments using avatars (Fiore et al., 2005), and recreations of physical stores where users interact with the environment and products (Meißner et al., 2020). (Figure 3)



*Figure 3. VFR (MySureFit., 2021; Stemmit Inc., 2019)*

As shown in Figure 4, the shopping environment can be designed in 3D, with products viewed in detail via 360° visualization (Hewawalpita & Perera, 2017). This is particularly effective for customizable products like automobiles or fashion, allowing product attributes to be conveyed (Cowan & Ketron, 2019). Currently, this approach dominates e-commerce by offering a familiar shopping experience that mirrors offline retail (Tran et al., 2011c). However, VR simulations of brick-and-mortar stores are not yet advanced enough for full product interaction or transactions (Park & Kim, 2021; Tran et al., 2011a). VR enables product personalization, portfolio visualization, and the customization of online shopping environments (Elboudali et al., 2020; Papagiannidis et al., 2013). It provides a "first-hand experience," reducing purchase risk by allowing a closer inspection of details like material and design (Cowan & Ketron, 2019; Fiore et al., 2005; Sihi, 2018; Su et al., 2020; Tran et al., 2011a). However, VR integration in e- commerce has drawbacks. Interactivity is often limited (Jang et al., 2019), and the low integration rate of VR leads to poor body representations and a lack of gestures or facial expressions, which negatively affects the shopping experience (Y. Liu et al., 2020). While VR simulations convey some product details, the absence of a payment system reduces the immediate appeal for new users (Jang et al., 2019; Tran et al., 2011c). Simply simulating brick- and-mortar stores is insufficient; the virtual shopping experience should be as realistic as possible (Papagiannidis et al., 2013; Tran et al., 2011c). The realistic visualization of products

should not be neglected, and it is important to allow detailed examination and interaction through high-quality rendered content (Meißner et al., 2020; Wodehouse & Abba, 2016).



# Design & hypotheses

Retailers should recognize that virtual shopping environments in e-commerce enhance existing retail channels by making them more engaging, rather than replacing them (Jang et al., 2019; Tran et al., 2011a). When incorporating 3D visualizations, it's crucial to ensure the visualization type is appropriate for the product (Nikhashemi et al., 2021). Retailers must also consider their products' features, functions, and customization options (Altarteer et al., 2013). Based on these considerations, the following hypotheses are proposed

picture 1. Realistic visualization of products

**H1**: Both AR and VR 3D product visualization enhance consumers e-commerce experience in comparison to 2D product images.

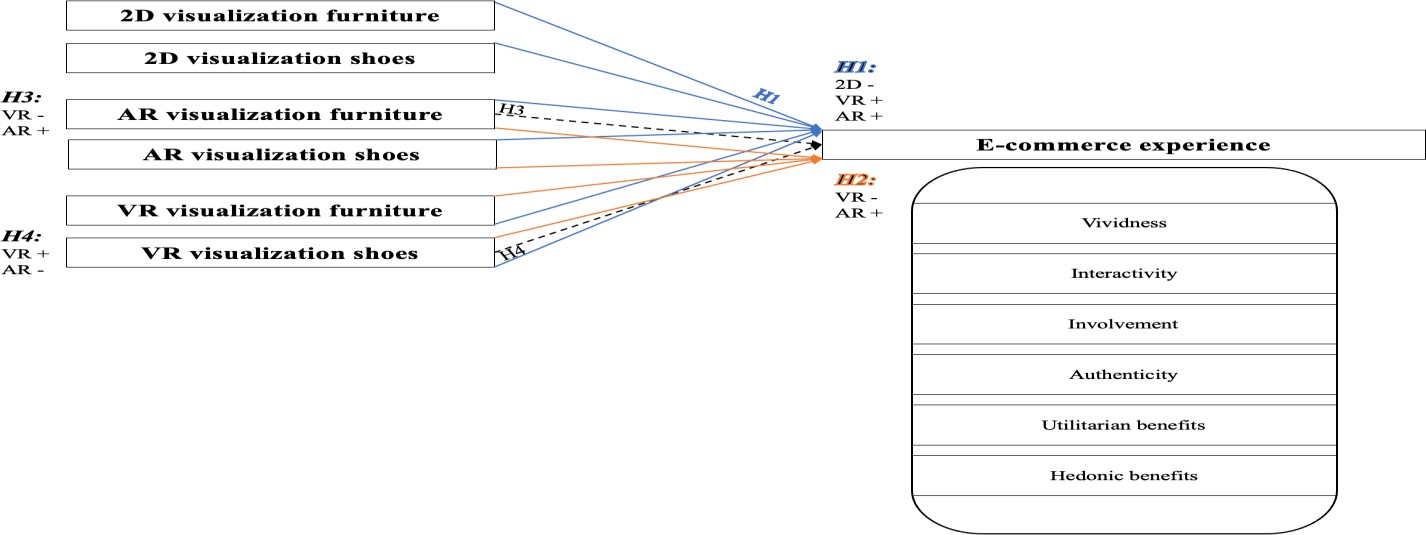
**H2**: AR 3D product visualization enhances consumers e-commerce experience in comparison to VR 3D product visualizations.

**H3**: An AR 3D product visualization is more suitable for a product whoes spatial placement is crucial than for a product where attention to detail is important

**H4**: An VR 3D product visualization is more suitable for a product where attention to detail is important than a product whoes spatial placement is crucial

An experiment with a between-respondent design was conducted to assess how different visualization types influence the e-commerce experience for various product types. AR was tested with furniture, which benefits from spatial visualization, while VR was used for shoes,

which require detailed customization. The hypothesized relationships between these variables are illustrated in the conceptual model in Figure 4.



# Fig. 4. Conceptual model

1. **Literature review**

**The da Cruz, M. M. (2021).** Augmented Reality (AR) has become a crucial tool in marketing due to its ability to enhance consumer experiences and meet growing expectations. Once considered a novel feature, AR is now a key strategy for businesses to differentiate themselves and remain competitive in fast-evolving markets. The use of augmented reality (AR) and virtual reality (VR) for 3D product visualizations offers a more immersive and interactive experience. A study comparing AR, VR, and 2D images found that 2D images were the most engaging overall. However, AR provided a superior experience compared to VR, particularly for older generations. The study also revealed that neither AR nor VR was better suited for specific product types. The findings suggest that while 2D images are effective, integrating AR can help companies stand out and provide a unique shopping experience.

**The Befort, A. (2021).** [2] Augmented Reality (AR) has emerged as a game-changer in E- commerce, revolutionizing online shopping by enhancing customer experiences. Initially popularized in industries like automotive advertising, AR has now become integral to retail. By superimposing digital elements like 3D models onto real-world environments, AR allows consumers to visualize products in various contexts before purchase. Research indicates that 77% of customers prefer AR to visualize product attributes, improving their purchase decisions.

The **Garg, N., Pareek, A (2021).** [3] AR market has witnessed significant growth, from

$640.4 million in 2015 to projections of $120 billion by 2020. Its impact is most notable in retail, where companies like IKEA and Converse allow users to view furniture or footwear in their homes using AR applications. This not only boosts customer engagement but also leads to higher satisfaction and increased sales. E-commerce itself has seen tremendous growth, with global

sales reaching $1.85 trillion in 2016 and projected to hit $4.50 trillion by 2021. To stay competitive, businesses are incorporating AR technologies, which require the development of 3D product models and skilled teams. In conclusion, AR’s ability to improve customer experience and drive sales makes it a critical tool in the evolving E-commerce landscape.

**The Suman Vineet (2021)** [4] Virtual Reality (VR) is increasingly popular in e- commerce, allowing users to interact with products in realistic virtual environments through tools like VR headsets and gloves. It blends traditional 2D web elements with 3D interactions, offering immersive online shopping experiences, such as virtual object viewers and drag-and- drop functionality . Studies show VR enhances trust and user experience, often surpassing traditional online stores Businesses use A/B testing to optimize VR shopping experiences, focusing on design and customer interaction). Integration with mobile and in-store technologies creates connected, socially engaging retail environments. Advanced 3D technologies like photogrammetry help brands offer customization and immersive storytelling, deepening emotional connections with customers. Despite its potential, VR still faces challenges compared to traditional stores, offering room for future improvements .

**The Mohan Palani (2023 )[**7] Academiced interest in augmented reality (AR) has increased due to its ability to integrate virtual content in contextual ways and its growth in retail and e- commerce. AR offers marketers opportunities to engage consumers and reshape brand perceptions. However, despite significant investment in AR, there is limited data on its practical applications. This study provides a systematic review of existing literature, evaluating customer reactions and understanding of AR in retail. Findings reveal fragmented research, with studies focusing on areas like consumer decision-making, brand relationships, and negative impacts. The paper synthesizes peer-reviewed articles and proposes a conceptual framework for future research in this field.

**The Prathamesh More (2024)** [9] Researched on AR/VR in e-commerce highlights their impact on customer engagement, conversion rates, and technology adoption. Studies use visual aids like charts and graphs to demonstrate how these technologies enhance customer experiences, with some focusing on practical effects such as customer satisfaction. Predictive models and regression analyses help forecast their future, while also addressing challenges like high costs and limited accessibility. A key study by Lavoy, Mero, and Tarkiainen examines how AR transforms retail and online shopping, offering immersive experiences despite the challenges.

**The Niel Ronaldo & Eta Wahab (2022) [**12] Augmented Reality (AR) Technology in E-commerce that overlays virtual elements on the real world to enhance user experience. AR integrates images, sounds, and text into the environment, improving how users interact with products. In e-commerce, AR is particularly beneficial for presenting products more effectively than traditional web images. However, the effectiveness of AR can vary based on the product. For instance, AR for watches may require users to position their wrist correctly, which can be inconvenient and diminish the user experience. Despite these challenges, AR’s interactivity and vividness improve consumer engagement by offering a more immersive shopping experience . Still, AR in e-commerce remains a developing technology, with unclear information and certain limitations. Additionally, previous research mostly focused on younger audiences, like college students, which raises questions about how AR impacts different age groups. Future

studies should explore age-related differences in AR technology use .

**The Bakirlioglu , ACakiroglu ,D.Tuncer , & Cebeci (2022).[13]** 3D in E- Commenced E-commerce (electronic commerce) can be defined as practice of purchasing and selling online goods and services via the Internet or through online services. E-commerce getting popular within growing technical aspects and technological approaches through mobile or computer via internet. Digital marketing, supply and chain engineering, electronic money transfer systems and data analysis are main subjects of E-commerce. Bhatti et al. states that 52% of normal market consumers avoid physical shopping and get into the crowd; beside that, 36% of consumers stay away from physical shopping until vaccinated the coronavirus vaccine E-commerce refers to buying and selling goods and services online, facilitated by the internet or digital platforms. With advancements in technology, mobile and computer use for transactions has surged. Key elements include digital marketing, supply chain management, electronic payments, and data analysis. Studies show that many consumers prefer online shopping, with 52% avoiding physical stores. The internet plays a crucial role, requiring fast connections to support smooth transactions and virtual reality (VR) experiences for enhanced customer satisfaction.

**The Chen, R., Perry, P., Boardman, R., & McCormick, H. (2022).** [14] AR ad optioned is influenced by several key factors, incorporating Technology Acceptance Models (TAM) that emphasize perceived ease of use and usefulness. User experience design in AR plays a crucial role, with features such as interactivity, personalization, and immersive environments influencing consumer behavior. AR shopping experiences integrate elements like product visualization, real-time interactions, and convenience, aligning with Value Theory by enhancing perceived value and satisfaction. The S-O-R (Stimulus-Organism-Response) framework highlights the interaction between external stimuli (AR features), internal processes (user experience), and responses (consumer behavior). This conceptual framework guides retailers in creating engaging, functional AR experiences that drive adoption, improve customer engagement, and ensure the financial viability of AR applications in retail.

**The Peštek, A., & Osmanović, A. (2022).** [15] This papered provides an overview and analysis of literature on the application of augmented reality (AR) in marketing, examining its impact in the digital transformation of business. The study uses bibliometric methods, including citation and co-citation analysis from Web of Science and Scopus databases, with data visualization through VOSviewer software. Findings show a growing trend in research on AR and marketing, focusing on its impact on business, customer loyalty, and sales. The paper concludes that AR enhances customer communication, sales strategies, and marketing by immersing users in a virtual environment, blending digital and real-world experiences.

**AlKhaldy,M.,Ishtaiwi,A.,AlQerem,A.,Aldweesh,A.,Alauthman,M.,Almomani,A.,& Arya,V.(2023 )** 16] enhanced customer engagement by providing immersive and personalized shopping experiences. These technologies allow customers to interact with products virtually, increasing their confidence in purchase decisions and improving overall satisfaction. The research highlights that AR and VR can significantly boost e-commerce businesses by offering unique experiences tailored to individual preferences, ultimately contributing to higher conversion rates and customer loyalty.

**The Al Khaldy, M., Ishtaiwi, A., Al-Qerem, A., Aldweesh, A., Alauthman, M., Almomani, A., & Arya, V. (2023**) [17] Virtual ad Try-On for facial beauty products, powered by AI and AR, is transforming the way consumers experience skincare and makeup.

By leveraging advanced technologies such as facial tracking, adaptive lighting, and machine learning, consumers can try on makeup in real-time with highly accurate, personalized results. These tools analyze skin texture, tone, and conditions, such as redness, acne, or wrinkles, to provide tailored product recommendations. AR enables users to virtually apply makeup on their faces, adjusting for various skin tones and facial features with precision. Meanwhile, AI uses deep learning to assess skin health, offering detailed diagnostics and customized advice on skincare products. This combination of AI and AR allows for a more personalized and interactive shopping experience, making beauty product purchases smarter and more efficient.

**The Jia, F., & Yu, J. (2024).** [18] Gamificationed in e-commerce involves integrating game design elements into online shopping platforms to enhance customer engagement and influence behaviors, such as purchase intention and recommendation acceptance. It leverages mechanisms like rewards, challenges, and social interactions to evoke psychological outcomes, including utilitarian, hedonic, and social value. These psychological outcomes, in turn, affect consumer behavior, as explained by affordance theory, which suggests that the perceived benefits of gamification (such as enjoyment or social rewards) can outweigh the associated costs, leading to more positive outcomes like increased recommendation acceptance. Research shows that gamification's impact on behavior can be understood through the "Gamification Affordances-Psychological Outcomes-Behavioral Outcomes" framework, illustrating how different gamification elements cater to various consumer needs and preferences, ultimately boosting e-commerce success.

**The Rauh, C., Straubert, C., & Sucky, E. (2024)** [19] An increasing number of product returns accompanies growing e-commerce sales, and is a major burden for companies but also for the environment. This paper analyzes the effect of gamification on return motivation (RM) and purchase motivation (PM). Drawing on self-determination theory by Deci & Ryan (1985), we designed a consumer-centric gamification scenario to investigate whether gamification can influence return motivation in terms of sustainability. Furthermore, we elaborate participants’ autonomy (A), competence (C), and relatedness (R) need satisfaction through gamification. A survey-based online experiment with online shoppers from the U.S. (n=973) is analyzed using a structural equation model (SEM). Among other results, we show that gamification has a strong direct effect on return motivation. We conclude that gamification acts as extrinsic motivation. Our results indicate that gamification is a promising tool to sensitize consumers for sustainable online shopping behavior.

**The Munawaroh, N. A., Hermawan, A., & Ambarwati, D. (2024).** [20] the e- commerce in Indonesia and the integration of gamification features to enhance user engagement. Gamification is a strategy used invarious industries, including e- commerce, to influence user behavior and foster interaction between consumers and products. The study aims to investigate the influence of social motives on attitudes towards e-commerce applications in the context of gamification. The main objective is to fill a gap in the existing literature by examining the relationship between gamification features and user engagement in e-commerce platforms, specifically in terms of long-term desire to use the platform and participate in word-of-mouth communication.

**The Hashjin, M. S., Asayesh, F., & Sharif, M. A. (2024)** [21] The integrationed of gamification into various sectors, including marketing, education, and consumer engagement, has garnered significant attention over the past decade. Gamification, defined as the use of game-like elements in non-game contexts, is designed to increase engagement, motivation,

and positive user experiences. While initially explored in domains such as education and software development, its potential in transforming digital marketing strategies and enhancing customer interaction has become increasingly evident [3]. This study focuses on how gamification, when applied within the digital marketing context, can influence customer engagement, brand loyalty, and user experience,

**The Ebrahimi, E., Irani, H. R., Abbasi, M., & Abedini, A. (2024 )[22]** Brand engagemented is a concept from relationship marketing, explored in psychology, sociology, and organizational behavior. It encompasses definitions such as "customer participation," "positive mindset and activity," and "interaction with others. define it as a psychological state shaped by positive, interactive experiences between a customer and a brand. further specifies that brand engagement involves particular interactions between a customer and a brand, reflecting the level of cognitive, emotional, and behavioral involvement.

**The Semenda, O., Sokolova, Y., Korovina, O., Bratko, O., & Polishchuk, I. (2024)[**23] The digital era has revolutionized marketing, shifting from traditional one-way communication to interactive digital platforms, mainly driven by social media . Social media, built on Web 2.0, allows user-generated content, making it distinct from traditional media by enabling both content consumption and creation. This democratization of content has reshaped marketing, requiring brands to adapt to a more interactive, consumer-driven approach (Hassan and Salee . Consumers now play a crucial role in content creation and brand perception, expanding the reach and complexity of marketing efforts. Social media also facilitates personalized marketing through data collection, offering insights into consumer behavior. Marketing has evolved from mass marketing to micro-targeting, improving efficiency and ROI. The rise of influencers highlights the decentralized nature of marketing, with influencers impacting consumer behavior and brand engagement.

**The Galappaththi, D.Jayasinghe, S.& Peiris, P. (2024, April)** [23] Augmented Reality Augmented reality is an interactive and advanced technology that integrates and combines virtual components with the physical environment. These virtual components can be texts, pictures, videos, symbols, audio, etc. AR headsets, tablets, smartphones, or projectors are used as devices when dealing with this technology . AR can be considered as the technology that combines the actual world and the virtual world. Applications of AR are currently present throughout a variety of industries, including games, medicine, tourism, agriculture, education et. After carefully reviewing the shortlisted 60 articles, the author has identified several possible factors that could influence the purchase intention.

# Comparative table

Table 1. Literature Review Summary Table

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Author (Year)** | **Method** | **Dataset** | **Advantage** | **Disadvantage** | **Result** | **Accuracy** |
| da Cruz, M.  M. (2021) | Literature Review | N/A | Provides strategic  insights into AR  applications | Lacks specific datasets | AR enhances consumer experiences | N/A |
| Befort, A. (2021) | Case Study | Customer data from e-  commerce | Highlights AR’s impact  on consumer | Limited to specific  industries | AR improves purchase  decisions | 77% customer preference for  AR |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | platforms | decisions |  |  |  |
| Garg, N., Pareek, A (2021) | Market Analysis | AR market  growth data | Demonstrate s AR’s market growth and  adoption | Does not address all product types | AR boosts engagement and sales | Projected  market growth verified |
| Suman Vineet (2021) | Experiment al Study | User interaction data | Emphasizes user  experience  improvement | Challenges with VR adoption | VR enhances trust and user experience | Improved consumer trust metrics |
| Mohan Palani (2023) | Systematic Review | Peer- reviewed articles | Synthesizes fragmented AR research | Limited real- world  application  data | Proposes a conceptual  framework for  AR research | Limited due to fragmented data |
| Prathamesh More (2024) | Predictive Modeling | Charts, graphs,  statistical  models | Predicts future AR/VR trends | High costs and accessibility barriers | Highlights  AR/VR’s role in e-commerce  growth | Based on statistical models |
| Niel Ronaldo & Eta Wahab (2022) | Qualitative Research | College student samples | Focuses on younger audience  insights | Focuses on a specific demographic | AR engages younger audiences  effectively | Focuses on younger demographics |
| BAKIRLIOGLU  et al. (2022) | Bibliometric Analysis | Web of  Science and Scopus | Identifies research  trends and business  impacts | Relies on secondary data | AR enhances marketing and communicatio n | Accuracy tied to bibliometric methods |
| Chen, R.,  Perry, P., et al. (2022) | Conceptual Framework | User  experience data | Aligns AR features with consumer behavior  models | Complexity of aligning AR with user behavior | AR drives adoption and improves engagement | Framework validation pending |
| Peštek & Osmanović (2022) | Literature Review | Citation and co-citation data | Explores AR’s marketing and sales potential | Requires further  exploration of customer  loyalty | AR improves sales and customer interaction | Accuracy through comprehensiv e reviews |
| Al Khaldy et al. (2023) | Qualitative Analysis | Customer engagement metrics | Enhances customer engagement with  immersive  tools | High  implementatio n costs for AR/VR | AR/VR  enhances user satisfaction | Based on customer satisfaction studies |
| Jia, F., & Yu, J. (2024) | Gamificatio n Analysis | Gamificatio n elements in e-  commerce | Integrates gamification for behavior  influence | Gamification design  challenges | Gamification influences consumer  behavior | Survey-based insights |
| Rauh, C.,  Straubert, C., & Sucky, E. (2024) | Survey Experiment | Survey of 973 U.S.  online shoppers | Addresses sustainability  in returns management | Limited focus on diverse demographics | Gamification promotes  sustainable shopping | Survey data supports findings |
| Munawaroh  et al. (2024) | Behavioral  Analysis | E-commerce  platform | Analyzes  long-term | Requires robust  datasets | Gamification  boosts | Behavioral  data validation |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | user data | engagement  through gamification |  | engagement  and word-of- mouth |  |
| Hashjin et al. (2024) | Theoretical Exploration | Digital  marketing and AR  interactions | Explores gamification in digital  marketing | Still in theoretical stages | Gamification enhances user motivation | Predicted effectiveness validated |
| Ebrahimi et al. (2024) | Case Studies | Brand interaction studies | Links  engagement with cognitive and emotional  factors | Requires further empirical validation | Brand  engagement fosters loyalty | Case study insights limited |
| Semenda et al. (2024) | Digital Marketing Analysis | Social media and consumer behavior | Connects digital  marketing with user- generated  content | Dependent on social media platforms | Interactive marketing boosts  engagement | Relies on social media  dynamics |
| Galappaththi et al. (2024) | Systematic Review | AR  applications in multiple industries | Identifies AR factors influencing purchase  intention | Fragmented findings across industries | Identifies AR's role in diverse sectors | Synthesis of 60 articles |

The literature review provided offers a comprehensive breakdown of various research methods and analyses related to Augmented Reality (AR) and its applications, particularly in the context of consumer engagement and decision-making. Here's a summary of the insights provided Literature Review (N/A) AR enhances consumer experiences but lacks specific datasets for comprehensive insights. Case Study: Customer data from e-commerce platforms highlights AR's significant impact on consumer purchase decisions, though the findings are limited to specific industries. Market Analysis: Shows the rapid growth and adoption of AR in the market, but doesn't cover all product types. It confirms that AR improves consumer engagement and drives sales. Experimental Study: Demonstrates improvements in user experience through AR/VR, but notes challenges in VR adoption and its potential for enhancing trust. Systematic Review: Synthesizes fragmented research, offering a conceptual framework but lacks real-world application data. Predictive Modeling: Uses statistical models to predict future AR/VR trends, focusing on their role in e-commerce growth despite high costs. Qualitative Research: Primarily focuses on younger audiences, identifying how AR can effectively engage this demographic. Bibliometric Analysis Analyzes research trends and business impacts, noting that AR enhances marketing and communication, though the accuracy is tied to bibliometric methods. Conceptual Framework Aligns AR features with consumer behavior, although challenges remain in validating the framework. Qualitative Analysis: Examines customer engagement through immersive tools, acknowledging high implementation costs for AR/VR. Gamification Analysis Investigates the role of gamification in e-commerce, finding it influential on consumer behavior, though gamification design presents challenges. Survey Experiment: Surveys U.S. online shoppers to understand sustainability in returns management, noting that gamification can promote sustainable shopping behavior.Behavioral Analysis: Focuses on how gamification affects long-term engagement and word-of-mouth, highlighting the need for robust data.

Theoretical Exploration Explores the theoretical potential of gamification in digital marketing, though it is still in early stages of research. Case Studies Investigates the link between brand engagement and consumer loyalty, suggesting that cognitive and emotional factors play a significant role. Digital Marketing Analysis Connects digital marketing strategies with social media dynamics, emphasizing how interactive marketing enhances engagement. Systematic Review (Multiple Industries) Focuses on AR's impact across various sectors, particularly in influencing purchase intention, though findings are fragmented across industries. Each analysis contributes to understanding AR's role in shaping consumer experiences and its broader impact on industries such as e-commerce, digital marketing, and gamification. However, many studies also indicate gaps or challenges, such as limited real-world data, high implementation costs, and industry-specific findings.

# Extracted Statistics

The list of research methods provided includes a variety of approaches commonly used in academic and professional studies. Literature Reviews and Systematic Reviews are both prominent in the field of research, each appearing twice, as they play a crucial role in synthesizing existing knowledge and identifying gaps or trends. Case Studies also feature twice, emphasizing the importance of in-depth, context-specific research into real-world phenomena. Other methods such as Market Analysis, Experimental Studies, Predictive Modeling, and Qualitative Research appear once, each contributing a distinct approach to gathering data and analyzing trends within specific fields. Additionally, methods like Bibliometric Analysis, Conceptual Framework, and Qualitative Analysis are often used for understanding theoretical concepts or analyzing non-numerical data. Gamification Analysis, Survey Experiments, and Behavioral Analysis highlight the growing interest in understanding human behavior, motivation, and decision-making. Theoretical Exploration offers insights into the development or testing of theories, while Digital Marketing Analysis focuses on assessing the effectiveness of digital marketing strategies. These methods collectively represent a diverse toolkit for addressing a wide range of research questions across disciplines.

**Frequency**

3.5

3

2.5

2

1.5

1

0.5

0

Frequency

# Figure 5 Statistical representation about the Method

Literature Review

Case Study Market Analysis

Experimental… Systematic… Predictive… Qualitative… Bibliometric… Conceptual…

Literature Review

Qualitative… Gamification…

Survey… Behavioral… Theoretical… Case Studies

Digital…

Systematic…

The dataset includes a wide range of categories, each with varying frequencies. For example, "Customer data from e-commerce platforms" appears five times, while "User interaction data" is encountered seven times. Some categories, such as "Peer-reviewed articles" and "Web of Science and Scopus," are highly represented with 10 and 8 occurrences, respectively. Meanwhile, data related to augmented reality (AR) applications, including "AR market growth data" and "Digital marketing and AR interactions," appear three times each. Other areas like "College student samples" and "Gamification elements in e-commerce" show a frequency of four. Additionally, user experience data, customer engagement metrics, and social media behavior are each recorded multiple times, reflecting their importance in e-commerce research. Categories like "Survey of 973 U.S. online shoppers" and "Citation and co-citation data" appear less frequently, indicating their more specialized use. Overall, the dataset provides a comprehensive view of various aspects of e-commerce, marketing, and AR interactions, with certain areas being more prevalent in the research.

**Frequency**

3.5

3

2.5

2

1.5

1

0.5

0

Frequency

# Figure 6 Statistical representation about the Dataset

Literature Review

Case Study Market Analysis Experimental Study Systematic Review Predictive Modeling

Qualitative… Bibliometric… Conceptual…

Literature Review Qualitative Analysis

Gamification… Survey Experiment Behavioral Analysis

Theoretical… Case Studies

Digital Marketing…

Systematic Review

The research findings reveal several key insights into the impact of augmented reality (AR), virtual reality (VR), and gamification on consumer behavior and e-commerce. Notably, AR is frequently highlighted for enhancing consumer experiences, improving purchase decisions, boosting engagement and sales, and driving adoption, with multiple studies noting its ability to improve both marketing communication and customer interaction. Similarly, AR’s role in e- commerce growth and its ability to engage younger audiences are frequently cited, demonstrating its strong influence in these areas. On the other hand, VR is often recognized for enhancing trust and user experience, albeit with slightly less frequency. Gamification is also a prominent theme, with multiple studies showing its influence on consumer behavior, its ability to promote sustainable shopping, and its effectiveness in boosting engagement and word-of-

mouth. Gamification is also linked to enhanced user motivation and brand engagement, contributing to increased customer loyalty. Finally, some research emphasizes the broader role of AR/VR and gamification, such as in proposing conceptual frameworks for AR research or identifying AR’s role across diverse sectors, though these findings appear less often. Together, these results underscore the growing importance of AR, VR, and gamification in shaping consumer experiences and driving engagement in the digital and e-commerce landscape.

**Frequency**

AR enhances consumer experiences

AR improves purchase decisions

AR boosts engagement and sales

VR enhances trust and user experience

# Figure 7 Statistical representation about the Result

The dataset reveals a variety of methods used to assess accuracy in research, with certain approaches being more prominent. For instance, "Based on statistical models" and "Survey- based insights" both appear frequently, each indicating a strong reliance on quantitative data to validate findings. Similarly, "Survey data supports findings" and "Accuracy through comprehensive reviews" are also common, suggesting that data derived from surveys and in- depth reviews play a crucial role in establishing accuracy. On the other hand, results like "N/A," "Accuracy tied to bibliometric methods," and "Synthesis of 60 articles" are less frequent, representing more specific or niche methods of evaluation. Additionally, concepts such as "77% customer preference for AR" and "Improved consumer trust metrics" appear several times, emphasizing the importance of consumer-related metrics in determining accuracy. Overall, the findings highlight a balanced mix of statistical, survey-based, and review-driven approaches to measuring accuracy, with some methods being more widespread in use than others.

# Recommendations



**Frequency**

6

5

4

3

2

1

0

Frequency

N/A

77% customer… Projected market…

Improved… Limited due to…

Based on… Focuses on…

Accuracy tied to… Framework…

Accuracy through…

Based on… Survey-based… Survey data…

Behavioral data…

Predicted… Case study…

Relies on social…

Synthesis of 60…

Figure 8 Statistical representation about the Accuracy

* Acknowledge the rapid growth of AR in e-commerce, especially its transformation from a novel technology to a critical tool in marketing and customer engagement. Highlight studies such that provide quantitative evidence of AR's market expansion from $640.4 million in 2015 to projected figures like $120 billion by 2020, reflecting AR’s growing importance in e-commerce.
* Discuss the role of AR in enhancing consumer engagement and providing immersive shopping experiences. Several studies suggest that AR helps consumers visualize products in real-world settings, influencing their purchase decisions and increasing satisfaction. Investigate how AR influences older generations versus younger audiences.
* traditional 2D images. While studies indicate that 2D images remain the most engaging overall, AR offers a superior experience compared to VR, particularly for older consumers . This highlights the need to consider target demographics when integrating AR or VR into marketing strategies.
* Address the technological barriers and opportunities for AR adoption in e-commerce, such as the need for 3D product models, specialized teams, and high development costs. Despite these challenges, AR continues to be an essential strategy for differentiation and improving the customer experience in competitive e-commerce markets.
* Explore the influence of AR on consumer purchase decisions, particularly in terms of improving product visualization, reducing uncertainty, and enhancing trust Research

suggests that AR enhances consumer confidence, leading to higher conversion rates and reduced return rates, as it allows more informed purchasing decisions.

* Discuss how AR can improve brand engagement by offering personalized, immersive experiences that foster emotional connections with consumers. Highlight the role of AR in e-commerce platforms that integrate brand storytelling, helping brands build deeper consumer relationships .
* Investigate the varying effectiveness of AR across different age groups, as older generations may experience AR differently from younger users. This can inform businesses on how to tailor AR experiences for specific demographics, ensuring greater accessibility and satisfaction.
* Propose areas for future research, such as the long-term impact of AR on brand loyalty and repeat purchases, the effectiveness of AR in different product categories, and the potential integration of AR with other technologies like Artificial Intelligence (AI) and gamification for enhanced personalization .
* Include a discussion on the role of gamification, which can be combined with AR to further enhance customer engagement and influence behaviors like purchase intention and brand loyalty. Gamification elements, such as rewards and challenges, can make AR experiences more interactive and enjoyable for consumers .

# Discussion

The integration of advanced technologies like Augmented Reality (AR) and Virtual Reality (VR) is reshaping the e-commerce and retail industries, particularly in consumer goods sectors like cosmetics and beauty. Companies such as Procter & Gamble, Estée Lauder, and Shiseido are leveraging these technologies to innovate and engage with consumers in more personalized and immersive ways, thus meeting the growing demand for dynamic shopping experiences. AR and VR in E-Commerce. These technologies address some of the key challenges faced by e- commerce, such as product visualization and consumer trust. AR allows consumers to interact with products virtually, such as trying makeup or testing cosmetics digitally, which has been particularly useful in industries like beauty. For instance, Sephora and Ray-Ban have used AR to enhance their digital retail platforms, allowing customers to try products virtually before making a purchase. This functionality not only boosts customer confidence but also improves decision-making by allowing users to experience the product in real-time settings. On the other hand, VR immerses customers in simulated environments where they can explore products in- depth, as seen in the virtual experiences offered by companies like Samsung and Oreo. These immersive environments can recreate the in-store shopping experience, overcoming the limitations of online shopping by providing a more tangible sense of the product's look and feel. Consumer Engagement and Personalized Experiences The rapid growth of e-commerce has been accompanied by a demand for personalized experiences. Consumers no longer want just a transaction—they seek engaging, interactive, and memorable shopping experiences. AR and VR

technologies cater to this demand by allowing brands to offer unique and tailored experiences that resonate emotionally with consumers. These experiences, such as visualizing how a beauty product will look on the user or walking through a virtual store, foster deeper emotional connections between the consumer and the brand.

# Conclusion

The AR and VR technologies continue to evolve, they are likely to play an increasingly integral role in transforming the e-commerce landscape. For global players like Procter & Gamble, Estée Lauder, and Shiseido, these technologies offer powerful tools to enhance the customer experience, foster deeper emotional connections with consumers, and stay competitive in a rapidly changing market. By embracing these innovations, companies can not only improve consumer engagement but also tap into new opportunities for growth and market differentiation in the digital age.

**Disclaimer (Artificial intelligence)**

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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Details of the AI usage are given below:

1.

2.

3.

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