Investigating the impact of AR apps driving consumer engagement in digital shopping

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Abstract
Diverse applications connected to augmented reality (AR) have become more prevalent as a result of the technology's innovation and growing popularity in recent years. By increasing brand visibility and appeal—which in turn affects customer interaction with brands—the incorporation of augmented reality (AR) into commerce presents a tremendous opportunity to improve marketing initiatives. Consequently, more funds are being allocated by retailers and brand owners to the AR commercial services industry. Using innovation diffusion theory and flow theory, this study intends to investigate the elements that influence consumer engagement with AR commercial systems, taking user happiness into consideration. To investigate the characteristics of AR technology that lead to user happiness and a flow experience, an integrated research model is put forward. Structural equation modeling was used to examine data from 250 legitimate online questionnaires. The results demonstrate that user happiness and flow experience are important drivers of consumer engagement with AR commercial services. Users' flow experiences and pleasure are found to be primarily influenced by three factors: interactivity, vividness, and novelty. There is also discussion on the implications of these discoveries.

Key Words: Flow Experience, User Satisfaction, AR Brand Engagement, Interactivity, Vividness

Introduction
More industry companies are investing in augmented reality (AR) applications as a result of the technology's recent global rise. Prominent corporations like Amazon, IKEA, and Nintendo have utilized augmented reality (AR) technology to pique customer curiosity and bolster their brand marketing and promotional campaigns(Du & Pan, 2021). Brand management, market analysis, and advertising tactics are all necessary to effectively manage the consumer experience, which is a major concern for companies. Businesses frequently employ interactive technology to provide additional value delight by merging virtual and real touchpoints in order to maximize the consumer experience. Technologies like as virtual reality (VR), augmented reality (AR), and mixed reality (MR) have the potential to greatly impact client experiences and provide varying degrees of interaction, such as direct supported experiences(Tarafdar et al., 2024). Experiences that are indirectly fostered and associated with empowerment empowering but divergent experiences. AR technologies have the potential to improve the consumer experience either directly or indirectly by combining the digital and physical environments at multiple levels. Head-mounted displays (HMD) and virtual reality (VR) technologies inspire empowered experiences that change users' perceptions in a completely digital world, unrelated to their fundamental experiences. (Kumar et al., 2024)Customers may accept diverse technology-enhanced experiences, which may be thought of as new kinds of hybrid experiences, as technologies advance to produce distinct degrees of reality. Specialized equipment is needed to access virtual reality services, which puts consumers at a disadvantage and may result in poor adoption of VR services(Belanche et al., 2024). Businesses that use VR technology at this early stage of development are unlikely to achieve significant market share, but they may attract customers interested in cutting-edge offerings. curiosity about cutting-edge services(Foroughi et al., 2024). Offering augmented reality services is a more practical option for businesses looking to strike a balance between market share and innovation. Since most individuals already have a mobile device, they don't need to buy extra gear to access AR services(Xue et al., 2024). Additionally, consumers who make decisions about their online purchases may have less cognitive dissonance when they use AR applications. When dissonance sets in, buyers usually give up or come to regret their selections(Herath Pathirannehelage et al., 2024). For example, AR technology can include product displays into actual environments and use AR filters to provide users additional information about the things they are looking at. As a result, AR ought to lessen consumers' perceived risk and cognitive load, enabling them to make better decisions with greater assurance and comfort. thus improving the purchasing experience and encouraging user contentment by lowering consumers' pre- and post-purchase dissonance(Javeed et al., 2024). Customer engagement is anticipated to rise with improved user satisfaction with augmented reality experiences. The proliferation of augmented reality (AR)-related technologies in many domains, such as e-commerce and educational training, has resulted in their increased adoption by industry participants, hence facilitating their sustained growth. Researchers claim that retailers and brands understand that incorporating augmented reality (AR) technologies into shopping offers a unique and engaging experience that can impact customers' purchase snd usage patterns(Dekhili & Ertz, 2024); this integration is equivalent to investing in AR-enabled e-commerce shopping platforms. Global commercial service-related sectors are changing as a result of the rapid advancement of augmented reality (AR) technologies; these companies are now producing 3-D virtual models of products. Virtual reality (VR) retail encounters and adjusting virtual products to the surroundings These technologies enable the creation of new business models by fusing virtual and physical purchasing experiences(Wu et al.,

2024). In order to satisfy customer expectations, businesses have been compelled to improve their operations through the use of augmented reality (AR) technologies as a result of the industry's rapid expansion. Furthermore, the development of AR encourages the invention of fresh applications and creative company plans in addition to the thorough modification and advancement of consumer models(Caboni et al., 2024). As virtual-real solutions that blend online and offline resources, Amazon, IKEA, BMW, LEGO, Target, Starbucks, Nintendo, and Toyota, for instance, have all released AR applications with improved functions. Thus, augmented reality (AR) has the potential to drastically change how consumers interact with platforms and the physical world, as well as to revolutionize the e-commerce retail sector. Companies gain from using developing technologies to increase shopping possibilities, and customers enjoy a better shopping experience as a result(Davis & Aslam, 2024). As augmented reality becomes more widely used, there will probably be a greater demand for AR-related applications on the market, which will likely lead to competition amongst industry participants. Numerous studies have shown that AR technologies are effective company marketing tools that support overall marketing objectives by increasing brand appeal, sales, and awareness. Driving customer AR-enabled brand engagement is therefore a critical business challenge(Qin et al., 2024). Research on brand engagement practices in relation to augmented reality technologies is scarce. In order to make more purchases, customers also need to be willing to interact with brands' augmented reality platforms. Consequently, in order to encourage brands to implement AR-enabled services, the current study investigates the variables that affect users' engagement with AR. Technology aspects of a new service or product influence people's views, attitudes, values, and actions toward it. According to the diffusion of innovation (DOI) hypothesis, examining a product or service's positive attributes can help comprehend how consumer acceptance or behavioral ambitions develop(Lin & Huang, 2024). The relative benefits of new technologies over current alternatives influence users' opinions of them or their willingness to embrace them, according to the DOI theory, which was put forth. Numerous studies have emphasized the special qualities of augmented reality (AR) technology, including their novelty, vividness, and interactivity—all of which are positive traits(Madi et al., 2024). In order to investigate the characteristics of technology that promote the proliferation of AR innovation, the current study takes the DOI viewpoint. Several academics have demonstrated that while using augmented reality (AR) technology to simulate reality, both practical and entertaining features are important to take into account. The most frequent adjective customers use to describe augmented reality goods or services is "enjoyable experience." Using flow theory, some research have looked at how delightful user experiences (Recalde et al., 2024). The psychologist who created flow theory defined it as a mental state in which an individual is totally absorbed in a task and feels invigorated, focused, and enjoying it. People are motivated to repeat these kinds of activities by this pleasurable sense of total immersion. found that a more positive flow experience affects contentment, which in turn leads to the desire to employ augmented reality services. Consequently, the link between a user's contentment with augmented reality and their decision to utilize it in the future is mediated by flow experience. In light of this, the current study suggests an integrated research model based on user satisfaction, flow theory's mediating role, and DOI theory to Three traits of augmented reality technology are identified in this study: novelty, vividness, and interaction. Customers' interactions with AR commerce apps take the form of several phases of flow, each with unique flow and satisfaction levels. Users' interactions with the application's augmented reality features cause these statuses to fluctuate(Wieland et al., 2024). examine how users interact with commercial AR services. However, there is a significant study vacuum in the literature since there hasn't been a practical organization of information on comparing the significance of different AR characteristics. Therefore, it is imperative to take into account the essential features that are included in AR technologies, as they have the capacity to elicit varying degrees of client happiness and flow(Chen et al., 2024). After a thorough evaluation of AR features, this study looks at the heterogeneity in the temporal dynamics of flow and satisfaction in an effort to provide a full knowledge of their effects on consumer engagement. It aims to respond to the following questions:

Can AR characteristics contribute to fostering an improved mental state of flow among customers after their interaction with an AR commerce app? Moreover, an examination is conducted to distinguish the specific AR characteristics that have significant influence over customers' flow experience and satisfaction levels. What is the mechanism underlying this effect? Furthermore, the study explores the possible consequences if users are unable to achieve flow or satisfaction, and it explores if these events might lead to increased usage of the AR commerce app. This research contributes to the body of knowledge by examining the factors that precede client involvement. Adaptability of upcoming advertising strategies.

Literature Review
2.1 Customer engagement

In marketing literature, customer engagement is a well recognized notion that is viewed as a context-dependent variable that arises from interactions between pertinent subjects and objects of participation. Companies want to boost consumer interaction with their brands. Giving clients access to technology resources including social media, websites, and media sites, gamification, virtual brand communities, as well as apps for mobile devices(Khan & Fatma, 2024). Affective, cognitive, and behavioural components of engagement can have either good negative adverse sentiment against the brand(Wang et al., 2024). An individual's basic interaction with technology might be classified as engagement. Nonetheless, genuine client interaction with a service must surpass basic interactions with various technologies. Previous research in the customer relationship management domain has shown that augmented reality experiences greatly foster innovative customer interaction, learning, entertainment, and travel. The phrase "AR brand engagement" is used in the

current study to characterize how people use and consume AR(han et al., 2024). To merely click on an augmented reality app would be a very minimal degree of interaction.

2.2 DOI theory

According to Rogers' 1995 DOI, a new service or product's acceptance is mostly influenced by how much better it is than the competition(Chakraborty et al., 2022). Technological features of a product, such as compatibility, complexity, testability, and visibility, might be considered relative benefits. In recent years, DOI theory has been cited by researchers engaged in a variety of cutting-edge technology services and product projects. who investigated how technical characteristics impacted medical information system adoption found that relative advantage had a direct and positive impact on adoption intention(Hu et al., 2024). shown that in a research of mobile payment wallet uptake and referral intent, relative advantage had an impact on usage intention and referral intent. shown that the intention to utilize social media was impacted by relative advantage.

Customers find that interaction, vividness, and novelty—the three most important aspects of augmented reality—to be its most enjoyable features. Using AR image recognition, users may combine the virtual and physical worlds by superimposing virtual things on real-world objects(Sadiq et al., 2021). Through augmented reality services, this technology allows consumers to participate in real-world commercial transactions(Al-Razgan et al., 2021). The current study makes the hypothesis that users' emotions are influenced and their brand engagement behaviors are enhanced during shopping experiences by the interactive, vivid, and innovative technological elements of AR technologies(Jaju & In Management, n.d.). As a result, this study expands on the DOI theory-based research paradigm to look into how AR's technology characteristics impact how customers see business services.

2.3 Flow theory

A person experiences the productive and pleasurable state of flow when they concentrate on a task and lose track of their surrounds. This has an impact on their behavioral goals. When someone is deeply enjoying something, they could put other things on the back burner in order to continue with the enjoyable activity(Lavoie et al., 2022). Furthermore, those who participate in an activity out of curiosity might be completely engrossed and like it, which encourages additional exploratory actions. Initially, flow theory was used to examine life, employment, sports, and leisure(Lavoie et al., 2022). Due to the Internet's explosive growth, researchers are now investigating whether flow theory can be used to studies on augmented reality mobile gaming, augmented reality mobile commerce, virtual reality (VR) technologies, digital learning, e-books, online buying, and social networking. With the use of gadgets like AR wearables, AR displays, and mobile carriers, users may fully immerse themselves in realistic AR experiences(Lavoie et al., 2022). Positive user experiences increase the likelihood that users will participate in further use activities, such making purchases. Thus, in light of flow theory, the current study explores the critical variables influencing consumers' desire to interact with companies using augmented reality.

2.4 User Satisfaction

According to academics, user satisfaction may be described as the difference between a customer's initial expectations of a good or service and their actual perception of its effectiveness or quality. Customers experience satisfaction when they believe a product or service meets or beyond their initial expectations in terms of quality or performance(Ogiemwonyi, 2024). Numerous research studies have examined a range of user satisfaction topics, including user satisfaction with augmented reality adoption, user satisfaction with wearable technology use, user satisfaction factors with mobile applications, user satisfaction factors with digital learning systems, and user satisfaction with e-book stores(Mahmud, 2024). According to research on augmented reality, customer happiness is critical to keeping consumers and encouraging them to use a service or product again. Technology systems are judged by their users as successful or unsuccessful(Dhir et al., 2021). According to service providers, customers are what keep businesses alive. Thus, it is essential to comprehend the elements that influence consumer happiness. Customers' intentions to re-use an AR product or service are influenced by their level of satisfaction(Hong et al., 2021). Thus, the current study makes the assumption that one of the main factors influencing customers' inclination to adopt augmented reality (AR) for brand interaction is user happiness.

3. Research Model and Hypothesis

A number of studies have emphasized the unique characteristics of augmented reality (AR) technologies, such as their interactivity, vividness, and novelty, all of which contribute to their relative advantages(Shehawy & Ali Khan, 2024). Previous studies have applied innovation characteristics to explain the adoption of emerging technologies, products, and services; however, Rogers stressed the significance of relative advantages in shaping individuals' perceptions of technologies(Deo & Prasad, 2024). Studies in the information systems field have shown that not all characteristics of technological innovations are relevant when analyzing emerging technologies, products, and services. The ability of augmented reality (AR) to produce rich sensory environments that allow users to interact with virtual things in a realistic way is referred to as vividness. Moreover, AR offers users new, distinctive, and unforgettable experiences by fusing virtual and real-world things(Dlamini & Mahowa, 2024). As a result, these characteristics are included in this study as predictive variables that influence the characteristics of AR technology. The goal of using AR technology in consumer encounters

is to make them immersive. Customers see scenarios that mimic reality and participate in immersive consuming experiences because to these AR capabilities(Mishra & Kaur, 2023). With AR beauty technology, for example, users may observe dynamic virtual cosmetics presentations in online venues. This type of immersive experience differs from typical consumption in that it involves the consumer in the effects that are displayed. (Dangelico et al., 2022) employing flow theory has examined enjoyable experiences inside AR environments and has shown a connection between flow experiences and positive emotional states. Customers' involvement behavior is thought to be significantly influenced by their flow experiences. Moreover, a better flow experience increases user pleasure, which in turn increases the inclination to engage with AR technology. (Zhuang et al., 2021)Users' flow experience acts as a mediator in the link between their intention to utilize AR and how satisfied they are with it. This study builds an integrated research model to examine the variables impacting customers' brand engagement behaviors using AR commercial services based on the aforementioned findings. The review of the literature shows that customers' utilization of AR-enabled services is mostly determined by aspects such as flow experience and user happiness. Additionally, the study suggests that customers' flow experiences and pleasure with AR technology are influenced by the relative advantage idea from the DOI theory. Fig. 1 shows the proposed research model.

3.1 Flow experience

According to flow theory, being in a state of total immersion and enjoyment in an activity is called flow. According to some academics, this kind of immersion is a transient, subjective feeling that motivates the desire to carry on with particular activities(Lavoie et al., 2022). When someone is totally involved in a task, blocks out irrelevant information, and becomes concentrated, they are said to be in a state of flow(Lavoie et al., 2022). Studies pertaining to augmented reality have revealed that consumers' adoption of AR technology is mostly influenced by their flow experience. When in an augmented reality environment, customers utilize their mobile devices to examine actual items and services(Lavoie et al., 2022). If they have a pleasant experience, users may participate and make purchases. showed that user happiness rises when users are completely engaged in augmented reality settings, and this has an impact on behavioural intentions. proved that the intention to interact with AR items is positively influenced by the flow experience, which corroborated this conclusion. As a result, when consumers like utilizing augmented reality technology, their desire to interact with the items grows. As a result, the current hypothesis is formed:

H1. Flow experience positively affects user (a) brand engagement (b) user satisfaction.

3.2 User satisfaction

defined user satisfaction as a cognitive process wherein a customer evaluates the discrepancy between the performance of a product—as it really performs—and their preconceived notions about it (before to purchase). Scholars have posited that satisfaction may be quantified by means of a comparison between the actual and expected performance or quality of a product or service following the user's experience(Zhang et al., 2021). Consequently, a client feels satisfied when they use a product or service and believe that the quality or performance of the product or service equals or surpasses their initial expectations. Numerous information systems research studies have shown that customer satisfaction is essential for keeping customers and encouraging them to use a product or service once more. As a result, several research have looked into what influences customer happiness. A few research have built models that employ theoretic views to precondition user satisfaction, with user behavioral intention (Qin et al., 2021) serving as the dependent variable and user satisfaction acting as a mediating variable. This study suggests that consumers' inclination to reengage with augmented reality is influenced by their level of pleasure or discontent with a product or service. Furthermore, as some academics have pointed out, user happiness increases the urge to interact with augmented reality surroundings. Thus, the current study suggests that customers' propensity to interact with AR goods is significantly influenced by their level of happiness. Consequently, the following hypothesis is proposed by this study:

H2. User satisfaction positively affects users' brand engagement intention with AR-based mobile applications.

3.3 Features of Augmented Reality

A person's experience with a novel technology or service in which the new technology is unquestionably seen as superior to the available alternatives is known as a relative advantage(Kosslyn et al., 2006). If consumers believe a new product or service has more advantages than those already available, then it has a relative advantage over the latter. More so than AR, VR technology may produce a sensation of immersion(Kim & Ko, 2010). Not every augmented reality application must provide users with a constant state of flow or a deep feeling of immersion. Therefore, it is imperative that businesses identify the necessary features that augmented reality (AR) apps should provide as well as the particular characteristics that create immersive experiences in AR apps(Gatter et al., 2022). According to several academics, the most beneficial aspect of augmented reality is its capacity to overlay digital data over the physical world. Real-world scenes are combined with virtual things on a screen to provide viewers with an engaging and educational experience that heightens their sense of realism(Kumar & Srivastava, 2022). The three distinct benefits of augmented reality technologies—interactivity, vividness, and novelty—have been emphasized by academics. AR technology provide people new experiences. AR systems allow for

AR Technology Characteristics
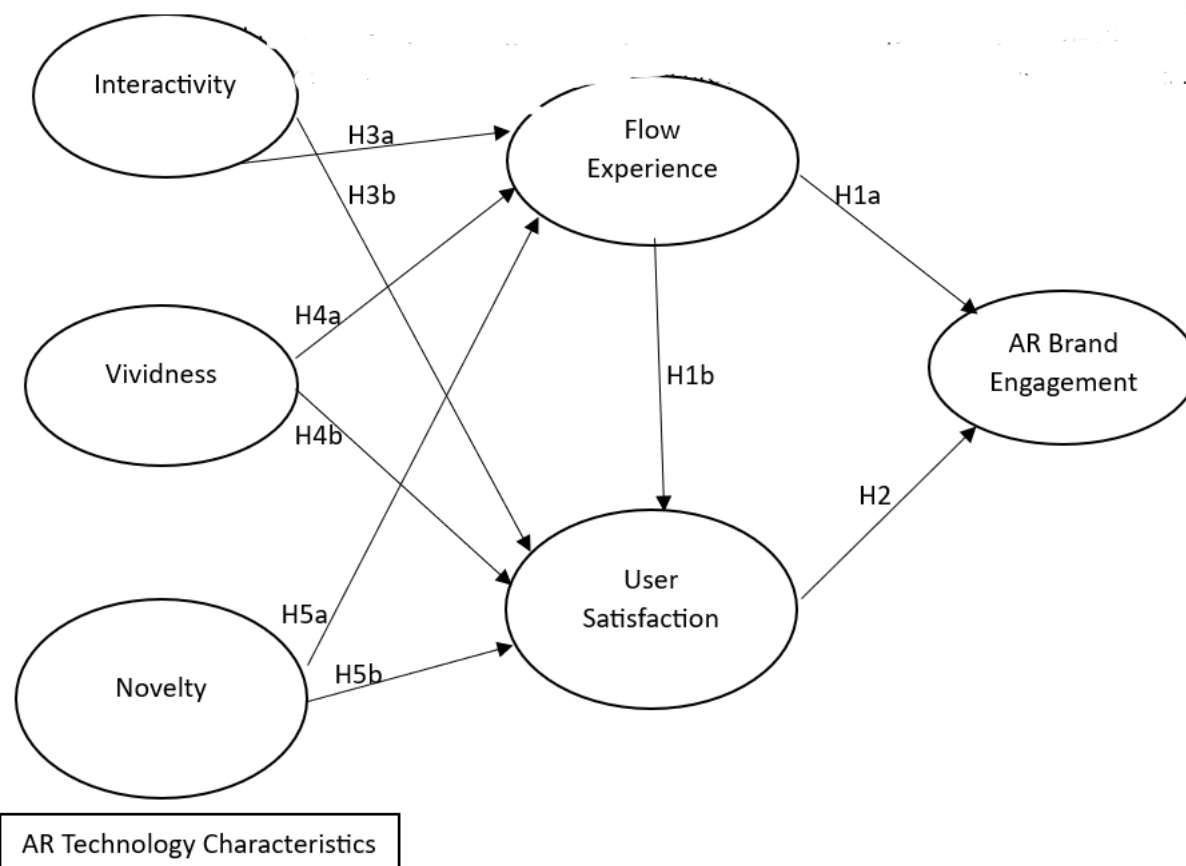
autonomous interaction and quick operation by providing the information and experience feedback that the environment requires based on dynamic contextual data(Foroughi et al., 2023). Vividness is the capacity of augmented reality (AR) to successfully multiply virtualization and realism by exhibiting items' scale, style, and color in a clear and concise manner, therefore providing rich and diversified product information. The supply of distinctive or customized content offerings for AR is referred to as novelty. For instance, users may set furniture in any space, such a living room or bedroom, and view it from any aspect with IKEA's AR set application. The program offers customers a distinctive and innovative shopping experience by allowing them to zoom in or rotate the AR carrier to evaluate how an item appears in their surroundings. According to the current study, customers can benefit from AR technology's relative benefits in terms of interaction, vividness, and novelty. Numerous academics have investigated the relative benefits that influence customers' propensity to utilize IT in different contexts(Manchanda & Deb, 2021). Researchers have found that consumers' behavioral intentions are positively impacted by the relative benefits of technology-related goods and services. The current study posits that users' intention to engage (e.g., engage with an AR brand) may be improved by the interactivity, vividness, and novelty of AR technologies. According to some academics, consumers' sentiments of enjoyment are positively impacted by relative advantages. Users enjoy improved sensations of vividness when the relative benefits of a technology product or service exceed their expectations, and novelty has a beneficial impact on users' perceptions of flow in augmented reality settings. shown that user pleasure is significantly impacted by the comparatively beneficial characteristics of IT(Saleem et al., 2022). Therefore, dynamic, colorful, and innovative functional applications may be achieved through the employment of AR technologies, 3-D video technology, and different virtual systems. Through the use of augmented reality (AR), the integration of online and physical resources may mimic consumer scenarios and give users a more enjoyable, immersive experience with products or services. According to the opinions of the scholars listed above, the present study proposes the following hypotheses:

H3. Interactivity positively affects user (a) flow experience and (b) user satisfaction.
H4. Vividness positively affects user (a) flow experience and (b) user satisfaction.
H5. Novelty positively affects user (a) flow experience and (b) user satisfaction.

4. Measurement
4.1 Scale and instrument
The majority of the items used for the constructs were modified from earlier studies to assure content validity. To make the goods more applicable to augmented reality-based e-commerce, they were slightly changed. Six components were included in the study model, and several items were used to measure each one. Modified versions of the studies'

interactivity, vividness, and novelty items were used. The suggested scale was used to evaluate flow experience. The user satisfaction metric was modified. Lastly, the same objects that were used to gauge AR brand engagement were also used. A 5-point Likert scale, with endpoints ranging from 1 (strongly disagree) to 5 (strongly agree), was used to measure each item. The survey questions and associated descriptive data for each concept are included in Table 2. In order to evaluate the discriminant validity and ascertain if there was a discernible difference between items across several constructs, the correlation coefficients between the constructs and the square root of the average variance extracted (AVE) were compared. In this study, the square root of the average variance of each dimension (AVE) was shown to be greater than the correlation coefficients between that dimension and the other dimensions in the model when it was placed on the diagonal of the matrix. Table 3 demonstrates that there was sufficient discriminant validity in this investigation since the square roots of the AVE between any two constructs were bigger than their corresponding correlation coefficients.

4.2 Sample size and data

Analyzing consumers of AR-enabled retail applications is the main goal of this study. We chose Indian IKEA Place customers for this study. One realistic, highly engaging application that incorporates augmented reality technology is IKEA Place. A questionnaire survey was used to collect empirical data, and respondent identities were confirmed. Out of the 250 legitimate replies, 130 were from women (52%) and 120 were from males (48%). 40% of the respondents were in the 26–35 age range, which was followed by 30% in the 19–25 age range, 20% in the 36–and over age range, and 10% in the under-18 age range. Of those surveyed, 40% said they used the app for browsing, 28% for information searches, 18% for product purchases, and 14% for order management. Of those who used the augmented reality function, 45% did so with a goal in mind and 55% did so for fun.The appropriateness of the sample size was validated for many reasons. First, a sample size of more than 150 is enough for doing confirmatory factor analysis, as shown by [78]. Second, the sample size need to be at least 10 times the number of constructs in the model, in accordance with the suggestion made. Given that there were nine components in the study's model, the sample size of 250 > 10 * 9 was considered adequate. Its adequacy is further confirmed by the fact that the sample size is within the range of previous research, which ranged from 150 to 220 people.

Table 1 Item analysis

Construct	Factor loading	CR	AVE	Alpha
Interactivity (IA)	0.90	0.90	0.76	0.90
Vividness (VN)	0.83	0.92	0.70	0.92
Novelty (NE)	0.89	0.93	0.77	0.94
Flow experience (FE)	0.85	0.89	0.73	0.88
User satisfaction (US)	0.88	0.93	0.81	0.93
AR brand engagement (BE)	0.88	0.94	0.79	0.94

Construct	IA	VN	NE	FE	US	BE
Interactivity (IA)	**0.86**					
Vividness (VN)	0.66	**0.83**				
Novelty (NE)	0.53	0.70	**0.87**			
Flow experience (FE)	0.60	0.67	0.78	**0.84**		
User satisfaction (US)	0.41	0.58	0.56	0.67	**0.89**	
AR brand engagement (BE)	0.55	0.64	0.63	0.75	0.61	**0.88**

Table 2. Discriminant validity

Note: The square root of the AVE for each construct is represented by the numbers provided on the diagonal, and the correlation coefficients between the constructs
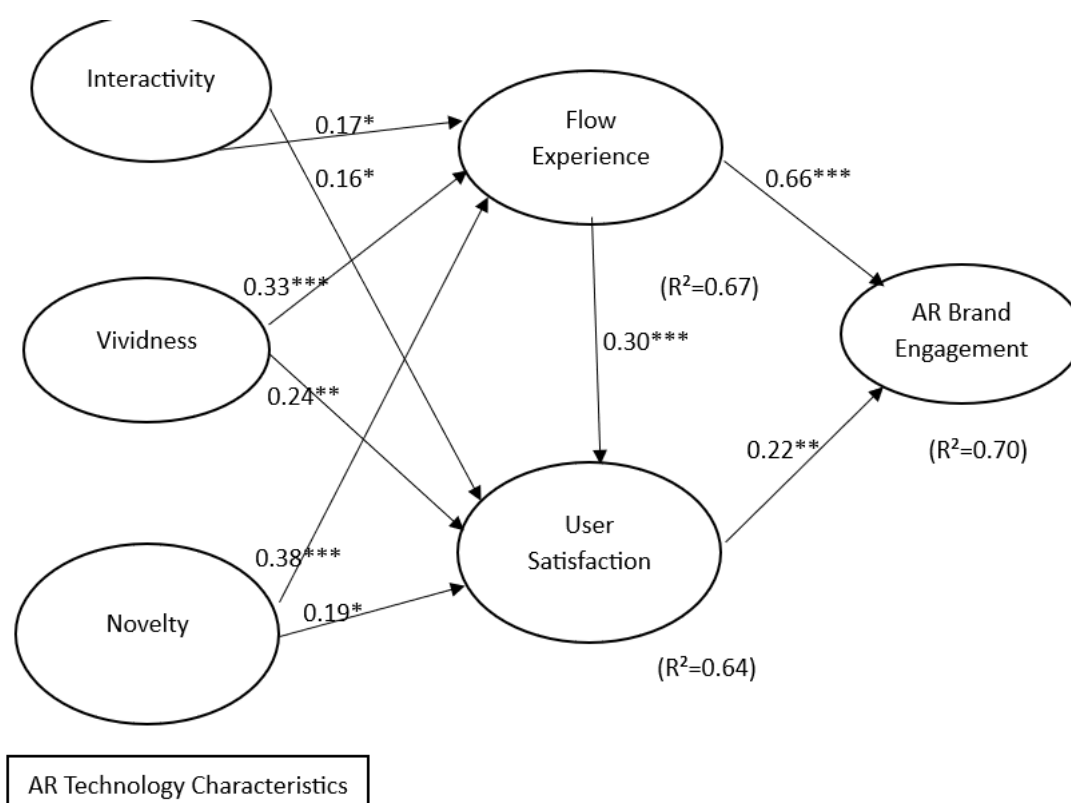
5. Result
5.1 Measurement model test
The concept validity and reliability of the measurement model are evaluated. Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE) are used in reliability and validity investigations. By calculating the Cronbach's alpha values for each construct, we first assess the measurement reliability. Every construct has a Cronbach's alpha between 0.88 and 0.94, over the suggested threshold of 0.7. Next, we assess the convergent validity of the model using three main metrics: (1) all loadings of the indicator factors must be more than 0.5; (2) the CR must be less than 0.7; and (3) the average value of each construct must be less than 0.5. Every item in the model has factor loadings greater than 0.7, as shown in. Constructs have CRs ranging from 0.89 to 0.94. The AVEs fall between 0.70 to 0.81. Consequently, the model's constructs all exhibit strong dependability and convergent validity.

5.2 Structural equation modelling
We conducted a structural equation modeling (SEM) analysis using AMOS 21.0 to assess the model fit and relationships between constructs. The model fit indices demonstrated an acceptable fit to the data (χ^2/df = 2.25, GFI = 0.84, AGFI = 0.80, NFI = 0.91, CFI = 0.95, RMSEA = 0.077), indicating that the hypothesized model appropriately reflects the observed data. Figure 2 illustrates the standardized path coefficients, their statistical significance, and the variance explained (R^2) for each of the dependent variables. All nine hypothesized relationships were supported by the SEM results, which confirm the validity of the proposed AR brand engagement model. Specifically, the results show that AR brand engagement is significantly predicted by both flow experience ($\beta = 0.66$, $p < 0.001$) and user satisfaction ($\beta = 0.23$, $p < 0.01$). Additionally, flow experience was found to have a positive and significant impact on user satisfaction ($\beta = 0.30$, $p < 0.01$), providing empirical support for hypotheses H1a, H1b, and H2. Further, flow experience is significantly influenced by three key attributes of AR technology: interactivity ($\beta = 0.18$, $p < 0.05$), vividness ($\beta = 0.34$, $p < 0.001$), and novelty ($\beta = 0.38$, $p < 0.001$), thereby confirming hypotheses H3a, H4a, and H5a. Similarly, user satisfaction is significantly affected by these same attributes—interactivity ($\beta = 0.17$, $p < 0.05$), vividness ($\beta = 0.25$, $p < 0.01$), and novelty ($\beta = 0.20$, $p < 0.05$)—providing full support for hypotheses H1b, H2b, and H3b. The explanatory power of the model, indicated by the R^2 values, is substantial. The model explains 71% of the variance in AR brand engagement, 68% of the variance in flow experience, and 65% of the variance in user satisfaction. These R^2 values demonstrate that the model has strong predictive capability for the dependent variables, particularly AR brand engagement, which is influenced by the flow experience and user satisfaction constructs. The results underscore the critical role of flow experience and user satisfaction in driving customer engagement with AR-based retail services, highlighting the importance of interactivity, vividness, and novelty as key drivers of these psychological experiences.

6. Discussion
This study offers an integrated research approach to examine how people connect with brands in AR-enabled purchasing environments from the viewpoints of user happiness, flow theory, and DOI theory. (Zanger et al., 2022) The findings show that the main variables influencing users' brand engagement when utilizing the AR shopping application were flow experience and user happiness. The present findings are consistent with prior research showing that flow experiences substantially influence commercial-oriented information system settings, since flow experience is the factor that most significantly affects users' brand engagement. In contrast to the corpus of current literature, flow experiences and user pleasure work together to explain AR brand engagement, which offers new insights. (Yim et al., 2017)Furthermore, this study finds that users' pleasure with the AR information system was highly impacted by their flow experience. The current study's results, which are consistent with prior research, show that flow experiences on online shopping platforms boost user satisfaction and may encourage other usage behaviors like engagement.(Alimamy & Al-Imamy, 2022) Thus, businesses that combine their brands with augmented reality technologies may fully include consumers in their buying experience; this level of participation may result in a flow experience for customers, which raises user happiness and encourages brand engagement behavior. Second, the findings show that user happiness had a major impact on how engaged users were with the brand via the augmented reality application. The results of this study are consistent with other studies showing that customers' desire to engage with a technology is positively impacted by their level of happiness with it. The current study's findings show that consumers' intentions to interact with the company were positively impacted by their level of pleasure with their augmented reality purchasing experience. Using virtual reality (VR) technology in retail settings can result in the creation of new business models (such as those that feature vibrant scenes and instantaneous visual feedback) that can successfully raise customer satisfaction levels throughout the purchasing process and increase the desire to interact with products. The three main attributes of augmented reality technology—interactivity, vividness, and novelty—have a direct and beneficial impact on user

pleasure and flow experience. This result is consistent with other studies that suggested elements like interaction, vividness, and novelty influence consumers' views of the relative benefits of AR technology. In terms of interaction, the results of this study show that a realistic, interactive augmented reality shopping experience is produced when virtual things on a carrier screen are seamlessly integrated with the physical surroundings. This is so that different interactive impacts can boost utility value and interest. Users will have a better user experience if the dynamic integration and spatial perception of AR filters are designed appropriately. Because of this, users could have a sense of immersion similar to that of shopping in the real world, which intensifies their enjoyment of the augmented reality technology and sets off the flow state. Moreover, the outcomes show that vividness had the most impact on user pleasure and flow experience. This research implies that the AR technology elements seen in physical retail settings provide customers with access to a wider range of information, including product dimensions, ingredients, style, and colour. Users may decide whether a product is acceptable for them and become closer to reality with the clarity and detail of AR functionalities. In fact, detailed information greatly enhances the realism of augmented reality apps by encouraging users to stay focused and to assist in achieving a state of flow, leading to increased user happiness. In conclusion, concerning novelty, the study's findings show that customers who thought AR features provided special or tailored content offerings while they were shopping expressed feeling more satisfied and in a state of flow. This is so that AR goods with genuine backgrounds may be integrated to create new, useful, and distinctive experiences through the union of reality and reality. The close-to-reality impact can give users points of recall, increase the level of realism in the encounter, and promote a deeper level of immersion in the scenario. Because this approach allows customers to feel flow and increases user happiness, AR suppliers should concentrate on the relative benefits of their technology goods or services and if they may improve consumers' service experiences.

7. Conclusion
7.1 Theoretical Implication
The current study's findings provide several insightful additions to the body of knowledge. First, in order to examine the aspects of AR technology that affect users' flow experience and degree of happiness in retail settings—which in turn creates brand engagement—this study offers an integrated research model based on DOI theory, flow theory, and user satisfaction. The documented empirical results do, in fact, support the existence of theories related to user experience design, such as those concerning immersion, useful functionality, and user satisfaction. As a result, a deeper comprehension of the impact of these factors on the AR technology user experience is gained. Thus, this is investigated in this study. Second, research has looked into how creative diffusion patterns used by IT systems influence user behavior. According to these research, a new technology's relative benefits have the biggest impact on consumers' adoption of it. Furthermore, researchers have noted that not all technological innovation attributes are pertinent when examining the factors associated with new goods, services, or technologies. Thus, the current study provides empirical confirmation of

the possible benefits of AR technology that influence user pleasure and the flow experience in AR purchasing environments: interaction, vividness, and novelty.

Ultimately, the findings show that the suggested model may accurately predict consumers' brand interaction on augmented reality shopping platforms, therefore the current study's findings can serve as a guide for similar research in the future.

7.2 Managerial Implication

Additionally, this study brings up a number of significant managerial issues for mobile application service providers and businesses. First, flow experience and user happiness have an impact on users' brand engagement on AR buying platforms. As a result, businesses using augmented reality technology into their brand must take into account both the recreational and the technological components of their information system (i.e., flow experience). It is important to prioritize the features that provide flow experiences in order to improve customer happiness and brand engagement. Users are encouraged, for instance, to actively engage in the testing and assessment of the user experience as well as the design process of AR functionalities. By using an iterative process, the design solutions are guaranteed to meet user expectations and attain the appropriate degrees of practicality and immersion.

Second, the current study found that one of the most important variables influencing user pleasure and flow experience is vividness. Consequently, businesses have to take use of augmented reality's benefits to give customers a rich and varied purchasing experience. Bright presentations that provide visual feedback on goods or services can encourage brand engagement by immersing consumers in a realistic purchasing experience. Mobile application service providers are recommended to actively investigate new technical avenues and cutting-edge techniques targeted at improving the vivid presentation of diverse items in order to effectively achieve vividness. It is imperative, however, that these technological advancements be immediately applied to the design of AR functionalities in real-world scenarios.

Limitations and future research direction

This study has a number of limitations in spite of its important conclusions and ramifications. Initially, the conclusions were derived from a single research that was carried out using indian sample data. Therefore, care should be used when extrapolating the results of research on AR mobile apps to different settings. Additional investigation carried out in various cultures and markets may examine and contrast the differences in the elements impacting AR brand interaction. Secondly, the investigation techniques employed were exclusively quantitative, restricting the participants to the predetermined elements in the research and perhaps excluding different user requests. In order to strengthen the scientific discourse, we advise that future studies include a qualitatively assisted quantitative approach. Third, all of the samples for this study were gathered within a set time frame using a cross-sectional research approach. As a result, just one instance of AR brand engagement was taken into account in the research. It is recommended that in the future, researchers do longitudinal analyses to monitor the evolution and circumstances surrounding subsequent usage practices. Additionally, this study points several areas that warrant more investigation. First, since the idea of flow state has attracted a lot of academic attention, the detrimental effects of flow experiences are still a main area of interest for researchers. Flow experiences are recognized to elicit appealing feelings, but as a function of product performance, their significance wanes. A less-than-ideal product consumption experience might lead to regret and cognitive dissonance. The importance of flow consciousness, which is the knowledge that one has entered a state of flow, has been highlighted by recent studies. There is a relationship between flow consciousness and less customer remorse.

Internet businesses should be mindful of the fact that customers are in experienced flow moods, which frequently lead to increased impulsive purchase. Customers may have less remorse if they are aware that they are in a flow state when making a purchase. As a result, companies and brands could develop tactics to make customers aware of their flow experiences, which might lead to more positive results like a decrease in the number of returns of merchandise. Examining how flow awareness affects consumer behavior after making impulsive product purchases, particularly with regard to negative emotional states like regret and cognitive dissonance, is an intriguing area for future research. Second, compared to positive consumer interaction, negative customer engagement has a higher persuasive potential. In particular, academics should focus on the negative manifestations that are seen in AR brand interaction. It is recommended that future studies concentrate on services within comparable technical settings, such as the use of brand-specific AR filters and interactive AR gaming experiences, as the study highlights items included in IKEA's AR application. Investigating the possible features of AR technology in these situations might be beneficial. Subsequent investigations might employ cognitive psychology theory to examine users' perception and cognition during immersion, while also taking into account the variations in perception across various user groups. This strategy will make it easier to create AR features that are suited to the unique requirements of various users.

Questionnaire

Constructs and items
Interactivity (IA)
1. I was in control of navigation during the AR experience.
2. I had some control over the AR technology that I wanted to use.
3. The AR technology responded to my specific needs quickly and efficiently.
Vividness (VN)
1. The visual display of the AR technology was clear.
2. The visual display of the AR technology was detailed.
3. The visual display of the AR technology was vivid.
Novelty (NE)
1. Using the AR feature is a new experience for me.
2. Using the AR feature offers unique information.
3. Using the AR feature provides a different experience each time.
Flow experience (FE)
1. I feel time passes quickly when using the AR feature on the app.
2. I felt curious when using the AR feature on the app.
3. I was entirely absorbed when using the AR feature on the app.
User satisfaction (US)
1. I am satisfied with the AR feature on the app as a shopping aid.
2. The AR feature on the app met my expectations.
3. Using the AR feature on the app makes me feel satisfied.
AR brand engagement (BE)
1. Using the AR feature on the app makes me think about the brand.
2. I often think about the brand when using the AR feature on the app.
3. Using the AR feature on the app stimulates my interest in the brand.

1. Alimamy, S., & Al-Imamy, S. (2022). Customer perceived value through quality augmented reality experiences in retail: The mediating effect of customer attitudes. *Journal of Marketing Communications*, *28*(4), 428–447. https://doi.org/10.1080/13527266.2021.1897648

2. Al-Razgan, M., Alrowily, A., Al-Matham, R. N., Alghamdi, K. M., Shaabi, M., & Alssum, L. (2021). Using diffusion of innovation theory and sentiment analysis to analyze attitudes toward driving adoption by Saudi women. *Technology in Society*, *65*. https://doi.org/10.1016/j.techsoc.2021.101558

3. Belanche, D., Belk, R. W., Casaló, L. V., & Flavián, C. (2024). The dark side of artificial intelligence in services. *Service Industries Journal*, *44*(3–4), 149–172. https://doi.org/10.1080/02642069.2024.2305451

4. Caboni, F., Basile, V., Kumar, H., & Agarwal, D. (2024). A holistic framework for consumer usage modes of augmented reality marketing in retailing. *Journal of Retailing and Consumer Services*, *80*. https://doi.org/10.1016/j.jretconser.2024.103924

5. Chakraborty, D., Siddiqui, A., Siddiqui, M., & Mohmmad H Alatawi, F. (2022). Exploring consumer purchase intentions and behavior of buying ayurveda products using SOBC framework. *Journal of Retailing and Consumer Services*, *65*. https://doi.org/10.1016/j.jretconser.2021.102889

6. Chen, H., Li, H., & Pirkkalainen, H. (2024). How extended reality influences e-commerce consumers: A literature review. *Electronic Commerce Research and Applications*, *65*. https://doi.org/10.1016/j.elerap.2024.101404

7. Dangelico, R. M., Alvino, L., & Fraccascia, L. (2022). Investigating the antecedents of consumer behavioral intention for sustainable fashion products: Evidence from a large survey of Italian consumers. *Technological Forecasting and Social Change*, *185*. https://doi.org/10.1016/j.techfore.2022.122010

8. Davis, L., & Aslam, U. (2024). Analyzing consumer expectations and experiences of Augmented Reality (AR) apps in the fashion retail sector. *Journal of Retailing and Consumer Services*, *76*. https://doi.org/10.1016/j.jretconser.2023.103577

9. Dekhili, S., & Ertz, M. (2024). Reinventing ecolabels in the era of augmented reality: An experimental study on the case of fair-trade coffee. *Journal of Cleaner Production*, *434*. https://doi.org/10.1016/j.jclepro.2023.139987

10. Deo, K., & Prasad, A. (2024). Factors Influencing Green Energy Consumer Behaviour in Australia. *Journal of Cleaner Production*, 142609. https://doi.org/10.1016/j.jclepro.2024.142609

11. Dhir, A., Sadiq, M., Talwar, S., Sakashita, M., & Kaur, P. (2021). Why do retail consumers buy green apparel? A knowledge-attitude-behaviour-context perspective. *Journal of Retailing and Consumer Services*, *59*. https://doi.org/10.1016/j.jretconser.2020.102398

12. Dlamini, S., & Mahowa, V. (2024). Investigating factors that influence the purchase behaviour of green cosmetic products. *Cleaner and Responsible Consumption*, *13*. https://doi.org/10.1016/j.clrc.2024.100190

13. Du, J., & Pan, W. (2021). Evaluating energy saving behavioral interventions through the lens of social practice theory: A case study in Hong Kong. *Energy and Buildings*, *251*. https://doi.org/10.1016/j.enbuild.2021.111353

14. Foroughi, B., Hongsachart, H., Asadi, S., Iranmanesh, M., Ghobakhloo, M., & Babaee Tirkolaee, E. (2024). Reuse intention of augmented reality apps: recreational consciousness as moderator: 增强现实应用的再使用意图：娱乐意识 (Recreational Consciousness) 作为调节因素. *Service Industries Journal*, *44*(7–8), 480–521. https://doi.org/10.1080/02642069.2023.2259313

15. Foroughi, B., Hongsachart, H., Asadi, S., Iranmanesh, M., Ghobakhloo, M., & Tirkolaee, E. B. (2023). Reuse intention of augmented reality apps: recreational consciousness as moderator. *Service Industries Journal*. https://doi.org/10.1080/02642069.2023.2259313

16. Gatter, S., Hüttl-Maack, V., & Rauschnabel, P. A. (2022). Can augmented reality satisfy consumers' need for touch? *Psychology and Marketing*, *39*(3), 508–523. https://doi.org/10.1002/mar.21618

17. han, J., Prabhakar, G., Luo, X., & Tseng, H. T. (2024). Exploring generation Z consumers' purchase intention towards green products during the COVID-19 pandemic in China. *E-Prime - Advances in Electrical Engineering, Electronics and Energy*, *8*. https://doi.org/10.1016/j.prime.2024.100552

18. Herath Pathirannehelage, S., Shrestha, Y. R., & von Krogh, G. (2024). Design principles for artificial intelligence-augmented decision making: An action design research study. *European Journal of Information Systems*. https://doi.org/10.1080/0960085X.2024.2330402

19. Hong, I. H., Chiu, A. S. F., & Gandajaya, L. (2021). Impact of subsidy policies on green products with consideration of consumer behaviors: Subsidy for firms or consumers? *Resources, Conservation and Recycling*, *173*. https://doi.org/10.1016/j.resconrec.2021.105669

20. Hu, F., Wu, L., Guo, Y., Liu, F., Yang, Y., & Wang, Y. (2024). How enterprises' public welfare low-carbon behavior affects consumers' green purchase behavior. *Heliyon*, *10*(8). https://doi.org/10.1016/j.heliyon.2024.e29508

21. Jaju, A., & In Management, M. (n.d.). *A study of the Impact of Green Marketing on Consumer Purchasing Patterns and Decision Making in Telangana, India*.

22. Javeed, S., Rasool, G., & Pathania, A. (2024). Augmented reality in marketing: a close look at the current landscape and future possibilities. In *Marketing Intelligence and Planning* (Vol. 42, Issue 4, pp. 725–745). Emerald Publishing. https://doi.org/10.1108/MIP-04-2023-0180

23. Khan, I., & Fatma, M. (2024). AR app-based brand engagement and outcomes: A moderated mediation approach. *Journal of Retailing and Consumer Services*, *76*. https://doi.org/10.1016/j.jretconser.2023.103618

24. Kim, A. J., & Ko, E. (2010). Impacts of luxury fashion brand's social media marketing on customer relationship and purchase intention. *Journal of Global Fashion Marketing*, *1*(3), 164–171. https://doi.org/10.1080/20932685.2010.10593068

25. Kosslyn, S. M., Thompson, W. L., & Ganis, G. (2006). *The Case for Mental Imagery*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195179088.001.0001

26. Kumar, H., Rauschnabel, P. A., Agarwal, M. N., Singh, R. K., & Srivastava, R. (2024). Towards a theoretical framework for augmented reality marketing: A means-end chain perspective on retailing. *Information and Management*, *61*(2). https://doi.org/10.1016/j.im.2023.103910

27. Kumar, H., & Srivastava, R. (2022). Exploring the role of augmented reality in online impulse behaviour. *International Journal of Retail and Distribution Management*. https://doi.org/10.1108/IJRDM-11-2021-0535

28. Lavoie, R., Main, K., & Stuart-Edwards, A. (2022). Flow theory: Advancing the two-dimensional conceptualization. *Motivation and Emotion*, *46*(1), 38–58. https://doi.org/10.1007/s11031-021-09911-4

29. Lin, K. Y., & Huang, T. K. (2024). Shopping in the digital world: How augmented reality mobile applications trigger customer engagement. *Technology in Society*, *77*. https://doi.org/10.1016/j.techsoc.2024.102540

30. Madi, J., Al Khasawneh, M., & Dandis, A. O. (2024). Visiting and revisiting destinations: impact of augmented reality, content quality, perceived ease of use, perceived value and usefulness on E-WOM. *International Journal of Quality and Reliability Management*, *41*(6), 1550–1571. https://doi.org/10.1108/IJQRM-10-2023-0314

31. Mahmud, A. (2024). How and when consumer corporate social responsibility knowledge influences green purchase behavior: A moderated-mediated model. *Heliyon*, *10*(3). https://doi.org/10.1016/j.heliyon.2024.e24680

32. Manchanda, M., & Deb, M. (2021). On m-Commerce Adoption and Augmented Reality: A Study on Apparel Buying Using m-Commerce in Indian Context. *Journal of Internet Commerce*, *20*(1), 84–112. https://doi.org/10.1080/15332861.2020.1863023

33. Mishra, S., & Kaur, R. (2023). Investigating consumer's buying behaviour of green products through the lenses of extended theory of planned behaviour. *Management of Environmental Quality: An International Journal*. https://doi.org/10.1108/MEQ-11-2022-0315

34. Ogiemwonyi, O. (2024). Determinants of green behavior (Revisited): A comparative study. *Resources, Conservation and Recycling Advances*, *22*. https://doi.org/10.1016/j.rcradv.2024.200214

35. Qin, H., David, A., Harun, A., Mamun, M. R. Al, Peak, D., & Prybutok, V. (2024). Assessing user benefits and privacy concerns in utilitarian and hedonic mobile augmented reality apps. *Industrial Management and Data Systems*, *124*(1), 442–482. https://doi.org/10.1108/IMDS-02-2023-0097

36. Qin, H., Osatuyi, B., & Xu, L. (2021). How mobile augmented reality applications affect continuous use and purchase intentions: A cognition-affect-conation perspective. *Journal of Retailing and Consumer Services*, *63*. https://doi.org/10.1016/j.jretconser.2021.102680

37. Recalde, D., Jai, T. C., & Jones, R. P. (2024). I can find the right product with AR! The mediation effects of shopper engagement on intent to purchase beauty products. *Journal of Retailing and Consumer Services*, *78*. https://doi.org/10.1016/j.jretconser.2024.103764

38. Sadiq, M., Bharti, K., Adil, M., & Singh, R. (2021). Why do consumers buy green apparel? The role of dispositional traits, environmental orientation, environmental knowledge, and monetary incentive. *Journal of Retailing and Consumer Services*, *62*. https://doi.org/10.1016/j.jretconser.2021.102643

39. Saleem, M., Kamarudin, S., Shoaib, H. M., & Nasar, A. (2022). Retail Consumers' Behavioral Intention to Use Augmented Reality Mobile Apps in Pakistan. *Journal of Internet Commerce*, *21*(4), 497–525. https://doi.org/10.1080/15332861.2021.1975427

40. Shehawy, Y. M., & Ali Khan, S. M. F. (2024). Consumer readiness for green consumption: The role of green awareness as a moderator of the relationship between green attitudes and purchase intentions. *Journal of Retailing and Consumer Services*, *78*. https://doi.org/10.1016/j.jretconser.2024.103739

41. Tarafdar, P., Leung, A. C. M., Yue, W. T., & Bose, I. (2024). Understanding the impact of augmented reality product presentation on diagnosticity, cognitive load, and product sales. *International Journal of Information Management*, *75*. https://doi.org/10.1016/j.ijinfomgt.2023.102744

42. Wang, Y., Jiang, Y., Liu, R., & Miao, M. (2024). A configurational analysis of the causes of the discontinuance behavior of augmented reality (AR) apps in e-commerce. *Electronic Commerce Research and Applications*, *63*. https://doi.org/10.1016/j.elerap.2023.101355

43. Wieland, D. A. C., Ivens, B. S., Kutschma, E., & Rauschnabel, P. A. (2024). Augmented and virtual reality in managing B2B customer experiences. *Industrial Marketing Management*, *119*, 193–205. https://doi.org/10.1016/j.indmarman.2024.04.007

44. Wu, J. F., Dong, J., Wu, Y., & Chang, Y. P. (2024). Shopping through mobile augmented reality: The impacts of AR embedding and embodiment attributes on consumer-based brand equity. *Information and Management*, *61*(6). https://doi.org/10.1016/j.im.2024.103999

45. Xue, Y., Sun, J., Liu, Y., Li, X., & Yuan, K. (2024). Facial expression-enhanced recommendation for virtual fitting rooms. *Decision Support Systems*, *177*. https://doi.org/10.1016/j.dss.2023.114082

46. Yim, M. Y. C., Chu, S. C., & Sauer, P. L. (2017). Is Augmented Reality Technology an Effective Tool for E-commerce? An Interactivity and Vividness Perspective. *Journal of Interactive Marketing*, *39*, 89–103. https://doi.org/10.1016/j.intmar.2017.04.001

47. Zanger, V., Meißner, M., & Rauschnabel, P. A. (2022). Beyond the gimmick: How affective responses drive brand attitudes and intentions in augmented reality marketing. *Psychology and Marketing*, *39*(7), 1285–1301. https://doi.org/10.1002/mar.21641

48. Zhang, G., Yue, X., Ye, Y., & Peng, M. Y. P. (2021). Understanding the Impact of the Psychological Cognitive Process on Student Learning Satisfaction: Combination of the Social Cognitive Career Theory and SOR Model. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.712323

49. Zhuang, W., Luo, X., & Riaz, M. U. (2021). On the Factors Influencing Green Purchase Intention: A Meta-Analysis Approach. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.644020