The impact of augmented reality on impulse buying of makeup products on e-commerce platforms

Giang Hoai Kieu Le[1,2*], Ky Van Nguyen[1,2]

[1]Ho Chi Minh City University of Technology, Ho Chi Minh City, Vietnam
[2]Vienam National University Ho Chi Minh City, Ho Chi Minh City, Vietnam
[*]Corresponding author: lhkgiang@hcmut.edu.vn

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ABSTRACT

The trend towards online shopping and the growing demand for makeup products among Vietnamese women have created both opportunities and fierce competition for e-commerce businesses in the makeup sector. To stand out, businesses need innovative strategies to capture attention and trigger purchase responses from customers. This study aims to explore how Augmented Reality (AR) influences customers' hedonic values and then leads their impulse buying, based on the Stimulus-Organism-Response (SOR) theory. By employing a quantitative method, 209 responses from Vietnamese female customers were gathered and then analyzed using Structural Equation Modeling (SEM) with SPSS and AMOS software. The findings of this study indicate that four AR characteristics, including product informativeness *(β = 0.538, p = 0.000)*, interactivity *(β = 0.377, p = 0.000)*, vividness *(β = 0.291, p = 0.000)*, novelty *(β = 0.163, p = 0.027)* positively affect customers' hedonic value. Subsequently, customers' hedonic value demonstrates a significant positive effect on their online impulse buying *(β = 0.567, p = 0.000)*. Furthermore, the results also show that hedonic value plays a perfect mediator in the relationships between AR characteristics and online impulse buying. The findings of this study also provide managerial implications for firms in the makeup sector using AR effectively on e-commerce platforms to benefit from enhancing impulse buying.

1. Introduction

With e-commerce driving, Vietnam has become one of the fastest-growing digital economies in Southeast Asia in recent years. Vietnam led the online shopping growth rate, with 78% of Vietnamese internet users engaging in online shopping, signaling a bright future for the country's e-commerce sector (Ministry of Industry and Trade, 2023). In addition, the prospects for Vietnam's beauty and makeup market are promising due to the growing demand for cosmetics, with a remarkable 62% of Vietnamese women wearing makeup daily or several times a week (Q&Me, 2022).

However, despite the positive signals for both Vietnam's e-commerce market and the beauty industry, makeup remains a category for which Vietnamese women are not yet fully ready for online shopping. The preferred channel for purchasing beauty products among Vietnamese women is physical stores rather than e-commerce platforms (Nguyen, 2024). The growing range of shades and colors available in today's makeup products, with hundreds of options catering to the diverse lip shades, skin tones, and personal preferences of customers, is the main reason. As a result, buying makeup in stores allows customers the opportunity to test out different samples. In contrast, customers may find it harder to choose the most suitable ones when shopping online because they can not physically hold, try on, or examine the products (Phuong Mai, 2021). Therefore, to attract more customers to online shopping, it is essential to meet the increasing demand for an online shopping experience that enables customers to interact intensively with products, especially makeup items. In this context, e-commerce businesses should approach distinctive strategies that can enhance customers' online shopping experience and effectively trigger their purchase behaviors in order to compete successfully in the online makeup sector.

In such a competitive market, e-commerce businesses need to recognize and resolve any barriers that hinder customers' online shopping experience. The absence of tactile product interactions, personalized experiences, and the inability to examine products before making a purchase all appear to cause concern among online shoppers, especially for beauty products (Prasad & Gudimetla, 2019). Given this context, Augmented Reality (AR) has been identified as an emerging technology with the potential to revolutionize the shopping experience (Duncan et al., 2013, as cited in Watson et al., 2018). By stimulating the real-world shopping experience and offering the potential to evaluate online products in the virtual world, AR technology presents clear advantages for both customers and businesses (Tavolieri, 2019). AR, particularly in e-commerce shopping, acts as a bridge between online and offline shopping by allowing customers to use their smartphones to visually assess products in terms of color, style, and size without needing to visit physical stores. This can address the limitations of online shopping and fulfill the demand for a more enjoyable shopping experience, thereby encouraging customers to engage more in online shopping.

Additionally, most businesses' primary goal is to get high profits. Impulse buying, in this context, can be an effective solution since it aligns with the current global trend of online shopping and has the potential to generate substantial revenue (Tran, 2023). Impulse buying is the act of consumers making sudden and unplanned purchases (Rook, 1987), which adds excitement to their lives (Wood, 2005). Previous studies have shown that online impulse buying can boost sales, increase profits, raise brand awareness, and potentially build customer loyalty (Chen & Chang, 2012; Wibisono & Fachira, 2021). Hence, by encouraging impulse buying, e-commerce businesses can gain a significant competitive edge over their rivals. Understanding customers' emotions is also crucial for business success in enhancing impulse buying. Customers' emotional states should not be overlooked, as understanding this aspect enables e-commerce businesses to predict customers' behaviors quickly, adapt to changing customer preferences, and develop successful business models (Pluta-Olearnik & Szulga, 2022). Referring to the emotional aspects of customer experiences with products, hedonic values recently gained significant attention among researchers due to their significant influence on consumer purchasing behavior (Yang et al., 2021). Previous studies confirmed that AR significantly impacts customers' hedonic values (Javornik, 2016; Kumar et al., 2023), potentially triggering their impulse buying behavior (Kumar et al., 2023).

Literature review shows that existing studies in Vietnam have examined factors that influence impulse buying, like packaging color (Nguyen & Hoang, 2023) and customers' trust (Tran, 2023). However, there remains a scarcity of research on how AR and hedonic value influence impulse buying behavior in Vietnamese makeup e-commerce. Hence, to fill this gap, this research aims to explore the impact of AR factors and hedonic values on customers' impulse buying. Additionally, this research wants to investigate the mediating role of hedonic values on the relationships between AR characteristics and online impulse buying by using the Stimulus-Organism-Response (SOR) model (Mehrabian & Russell, 1974). This theoretical framework has long been recognized as a model for studying consumer behavior (Nguyen & Nguyen, 2022). It explains how external Stimuli (S) trigger an individual's perceptions and feelings (O), which then influence their responses and behaviors (R) (Lee & Chen, 2021). The findings of this research can help e-commerce businesses increase online impulse purchases among their customers, enabling them to create effective strategies to boost sales and profits in the makeup sector.

2. Theoretical foundation

2.1. Impulse buying

According to Stern (1962), impulse behavior refers to any purchase made by a shopper without prior planning. Similarly, Piron (1991, p. 512) defined impulse buying as "a purchase that is unplanned, the result of an exposure to a stimulus, and decided on the spot." Impulse buying involves hedonic purchase decisions, which excludes reminder purchasing activities. Hence, it is described as an experience of a sudden, strong, and irresistible urge to buy (Muruganantham & Bhakat, 2013). Nowadays, the advent of the internet has facilitated the phenomenon of online impulse buying. Many researchers suggest that the online shopping environment encourages impulse purchases more than traditional offline shopping does (Iyer et al., 2020).

Enhancing impulse buying is an effective strategy for selling products as it can attract new customers, boost sales, and maintain strong customer relationships (Chan et al., 2017). In today's competitive market, impulse buying is a major revenue stream for online retailers (Yendola & Windasari, 2022). Hence, understanding the factors influencing online impulse buying is crucial for e-commerce platforms and firms to develop effective business strategies.

Impulse buying has become an interesting topic attracting many scholars worldwide, the literature review indicates that research on this topic in Vietnam remains limited. Some determinants of impulse buying, such as packaging color (Nguyen & Hoang, 2023), customer trust, and promotions (Tran, 2023), have been identified. Therefore, there is a need for further exploration of drivers of impulse buying, particularly within the highly competitive and rapidly expanding e-commerce sector, where emerging technologies like augmented reality play a crucial role. This study aims to contribute to the existing literature by examining factors influencing online impulse buying behaviors in the e-commerce market, with a specific focus on augmented reality technology for makeup products.

2.2. Augmented Reality (AR)

Augmented Reality (AR) is a technology that combines computer-generated objects into the real world, creating a coexisting physical and virtual environment (Olsson et al., 2011). With AR, users can see virtual products in their surroundings or on themselves in real

time through a webcam or smartphone camera, enabling them to examine the product from different angles and move around to get a better idea of how it would look (Smink et al., 2019). There are five AR characteristics, including interactivity, vividness, novelty, system quality, and product informativeness (Gabriel et al., 2023):

Interactivity is defined as "the ability to control what the user sees, combining the real world with the virtual world" (McLean & Wilson, 2019, p. 06). AR interactivity in e-commerce platforms allows users to easily interact with virtual products and be directly involved with the content that AR visualizes (Yim et al., 2017).

Vividness refers to how good and clear the visualization of products is, enabling users to have a realistic sensory experience when visualizing a product through AR (McLean & Wilson, 2019).

Novelty refers to how effectively current virtual try-on features in e-commerce allow users to envision themselves with a personalized and refreshed appearance (McLean & Wilson, 2019).

System quality refers to the reliability and accuracy of AR technology systems in presenting products, ensuring that the system meets the user's needs without any issues while trying out products (Kowalczuk et al., 2021; Ramdani et al., 2022).

Product informativeness refers to the amount of information provided about products through AR features (Ramdani et al., 2022), and the effectiveness of that information in fulfilling users' needs (Gabriel et al., 2023; Kowalczuk et al., 2021).

The application of AR has recently expanded to various industries such as tourism (Chung et al., 2015), the beauty industry (Yim et al., 2017), games (Kogan et al., 2017) and healthcare (Leone et al., 2021). Retailing has been seen as one of the sectors with immense potential for AR implementation (Bonetti et al., 2018). In today's e-commerce, AR is a highly beneficial feature (Whang et al., 2021) that can create "try before you buy" experiences by providing virtual product presentations that closely resemble a direct physical one (Smink et al., 2019). A notable application of this feature is its use in facial recognition to showcase makeup products (Smink et al., 2019), commonly known as AR "virtual try-on." This feature provides users with the feeling of actually using the product, thereby addressing the critical challenge of accurately displaying the color of the original product, which is a common problem for online makeup shoppers (Gabriel et al., 2023).

2.3. Hedonic value

According to Babin et al. (1994, p. 654), hedonic value is defined as the subjective pleasure and emotions experienced by customers, including the feelings of "enjoyment, excitement, captivation, escapism, and spontaneity." To be more specific, hedonic values are linked to emotive aspects, such as entertainment, and pleasure-oriented values, like enjoyment, fun, and recreation, all derived from one's experiences with products (Nikhashemi et al., 2021).

Hedonic value is considered a crucial factor that influences consumer purchase behavior, as hedonic individuals tend to spend more time shopping, make more frequent purchases, and buy larger quantities of products (Andriani et al., 2021; Yang et al., 2021). To gain a competitive advantage, retailers are now encouraged to foster these values in customers by emphasizing the pleasurable aspects of shopping, as customers are more likely to spend more with retailers that offer enhanced hedonic value (Ponsignon, 2023). The

significance of hedonic values is particularly relevant in the e-commerce context, where interactive experiences between products and consumers are indispensable for creating an engaging and enjoyable shopping experience (Bonnin, 2020).

Customer experiences with AR tend to lean more towards hedonic value rather than utilitarian value (Hsu et al., 2021; Javornik, 2016). Hence, the impact of the AR feature on customers' hedonic value as well as customer behaviors has been investigated in different contexts such as fashion area (Arghashi, 2022; Bonnin, 2020), online shopping applications (McLean & Wilson, 2019; Nikhashemi et al., 2021), and make-up applications (Hsu et al., 2021). Therefore, in the online shopping context, the present study wants to examine the impact of AR characteristics on customers' hedonic value, then potentially leading to online impulse behavior.

2.4. The Stimulus Organism Response (SOR) Model

The Stimulus-Organism-Response (SOR) model originated from the Stimulus-Response theory, providing an explanation for individuals' behaviors as learned responses to external stimuli (Zhang & Benyoucef, 2016). Later, the SOR model was enhanced by adding the concept of "organism" between stimulus and response, accounting for individuals' cognitive and emotional states before their behavioral responses (Zhang & Benyoucef, 2016).

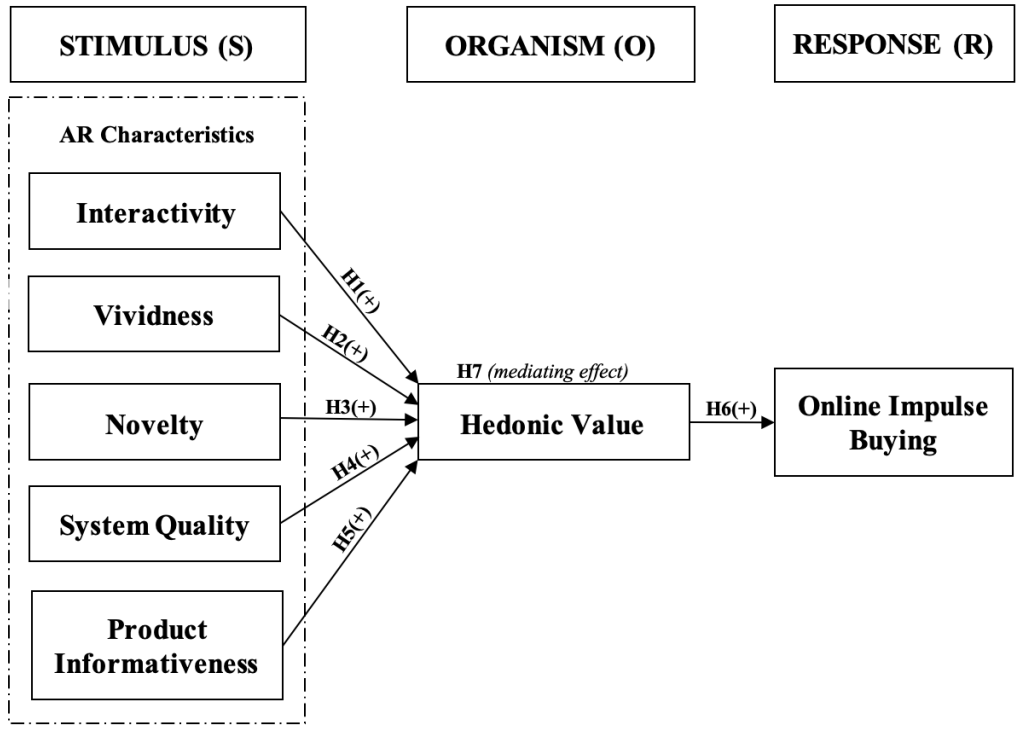
The SOR model consists of three key elements that define the online consumer experience, namely Stimulus (S), Organism (O), and Response (R) (Wang et al., 2021). The Stimuli (S) are external factors beyond an individual's control that have the power to impact the internal states of organisms when they are exposed to these external forces (Lee & Chen, 2021). Next, the Organism (O) represents an individual's affective and cognitive states (Basha et al., 2022), serving as an intermediary state between stimulus and response (Zheng et al., 2019). Finally, the Response (R) is the decisive outcome that shapes consumer behavior or avoidance (Kamboj et al., 2018). This SOR model has been employed by many scholars, especially in the online shopping context. For instance, Arghashi (2022) used this model to investigate the impact of AR features on customers' motivation and purchase intention in online shopping for sportswear products. Gabriel et al. (2023) applied the SOR framework in the context of fashion and beauty products. Another study by Nikhashemi et al. (2021) employed the SOR to reveal how AR attributes trigger hedonic and utilitarian benefits, and finally, leading to consumer behavioral consequences in online shopping apps such as Amazon. Accordingly, in the present study, we used the SOR framework in the context of makeup products on e-commerce platforms such as Shoppee and Lazada in Vietnam. The SOR helps to examine how AR characteristics such as interactivity, novelty, vividness, etc. (Stimuli) influence customers' hedonic value (Organism) and then drive their online impulse buying behavior (Response).

3. Conceptual model and proposed hypotheses

Drawing on the SOR model, the proposed research model is illustrated in **Figure 1**. In this model, five AR characteristics (interactivity, vividness, novelty, system quality, and product informativeness) represent the Stimulus (S). The hedonic value represents the Organism (O). The customers' online impulse buying, represents the behavioral Response (R). The following sections will provide the elaboration for each hypothesis.

Figure 1

The Proposed Research Model



Note. The Authors

3.1. The effect of AR characteristics on hedonic value

3.1.1. The effect of the interactivity on hedonic value

AR interactivity is "the ability to control what the user sees by combining the real world with the virtual world" (McLean & Wilson, 2019, p. 06). Previous studies have confirmed that interactivity is a crucial factor in AR that significantly enhances the overall customer experience (Kristi & Kusumawati, 2021). The higher level of interactivity makes AR especially suitable for helping customers actively interact with products and engage more effectively with online shopping environments (Kumar & Srivastava, 2022). In fact, given the inability to examine makeup products when shopping online, women often go through the unpleasant experience of selecting the wrong base colors and shades. However, the interactivity of AR technology can help users visualize how a makeup product would look on themselves. In the SOR model, AR interactivity acts as a stimulus that is capable of generating positive hedonic experiences for users (Hsu et al.,2021). Therefore, it is suggested that the greater the interactivity of AR features, the greater enjoyment customers experience, thus leading to an increased perception of hedonic value among them. Hence, the following hypothesis is proposed:

H1: Interactivity has a positive effect on hedonic value

3.1.2. The effect of the vividness on hedonic value

Vividness refers to good and clear product visualization when being viewed through AR (McLean & Wilson, 2019). Specifically, vividness in AR is related to the aesthetic quality of online product presentations, which facilitates customers' understanding of a product's performance, including its appearance, functionality, behavior, and the

forthcoming experience with it (McLean & Wilson, 2019). This factor is particularly significant as customers desire virtual makeup products that accurately resemble the original ones (Kristi & Kusumawati, 2021). That is why the greater the AR visual vividness in online product displays, characterized by higher-quality visuals, the more enjoyable the experience gained by customers (McLean & Wilson, 2019; Yim et al., 2017). Particularly, AR vividness, acting as a stimulus in the SOR model, can stimulate enjoyment during a customer's experience due to its ability to generate images of the integrated virtual and real-world experience in such a unique, clear, and detailed way (McLean & Wilson, 2019). As a result, vividness can increase customers' hedonic value when they use AR to try makeup products. Based on these arguments, the following hypothesis is proposed:

H2: Vividness has a positive effect on hedonic value

3.1.3. The effect of the novelty on hedonic value

The AR characteristic of novelty refers to the new, unique, and personalized stimuli that users receive through AR displays (McLean & Wilson, 2019; Nikhashemi et al., 2021). When shopping for makeup items online, AR offers unique and personalized experiences by allowing individuals to select the available shades and colors of products and try them on themselves until they find a match with their needs and preferences (Gabriel et al., 2023). Customers can see a visualization of how a makeup product would appear on them and determine whether it is a perfect fit, providing a similar experience to real shopping (Gabriel et al., 2023). This novelty makes e-commerce platforms equipped with AR try-on features promptly stimulate users' enjoyment (Nikhashemi et al., 2021). It provides customers with a personalized experience, preventing them from becoming bored with outdated features and product options (Kristi & Kusumawati, 2021). Therefore, in the SOR model, such AR novelty can act as a stimulus that triggers the process of perceiving hedonic value during customers' shopping experiences. Hence, the next hypothesis is proposed:

H3: Novelty has a positive effect on hedonic value

3.1.4. The effect of the system quality on hedonic value

System quality is defined by the ability to provide prompt, efficient, and accurate services, ensuring reliability and error-free performance (Kowalczuk et al., 2021; Ramdani et al., 2022). AR system quality is a crucial factor constituting the user experience in online shopping (Kowalczuk et al., 2021). Particularly in makeup products shopping, this AR characteristic ensures the delivery of reliable and accurate product presentations (Ramdani et al., 2022). In addition, it also ensures the provision of quick and smooth visualization without delay and is similar to real life, thereby significantly enhancing the pleasure experience of online shopping (Gabriel et al., 2023; Ramdani et al., 2022). Accordingly, it results in a pleasant and seamless shopping journey for customers. The system quality characteristic of the AR feature can be considered as a stimulus in the SOR model that evokes affective feelings of excitement and enjoyment in customers' perception, hence enhancing customers' hedonic values. Thus, the following hypothesis is formulated:

H4: System quality has a positive effect on hedonic value

3.1.5. The effect of the product informativeness on hedonic value

Product informativeness refers to the extent to which AR provides relevant and helpful information about a product to customers during their try-on experience (Kowalczuk et al.,

2021; Ramdani et al., 2022). Commonly, online shopping without AR features can only provide factual details about the search attributes of makeup products. Therefore, they are less effective in conveying the experience attributes, which can only be fully appreciated through actual use (Smink et al., 2019). To solve this problem, the informativeness of AR features compensates for the lack of product information and the inability to examine products in online makeup shopping by merging reality and virtuality to offer highly informative product presentations (Nagy et al., 2022; Poushneh, 2018). Product information presented through AR features is perceived as more enjoyable compared to presentations without this informativeness (Smink et al., 2019). As a result, it leads to an increase in hedonic values for customers (Hsu et al., 2021; Nagy et al., 2022). This informativeness attribute of the AR function can be seen as an environmental stimulus, directly stimulating customers' perception of hedonic value. Hence, the fifth hypothesis is proposed:

H5: Product informativeness has a positive effect on hedonic value

3.2. The effect of hedonic value on customers' online impulse buying

The relationship between hedonic value and online impulse buying can be explained by the SOR theory. In this study, hedonic value is mentioned as the enjoyment experienced during shopping, which arises from an individual's cognitive process (organism) when they are exposed to stimuli in their environment, such as AR features on e-commerce platforms. This pleasure state will result in one's unplanned purchases as the response (Zheng et al., 2019). Conspicuously, it is found that when one finds higher enjoyment and entertainment in shopping, they may potentially increase the likelihood of buying unplanned (Lee & Wu, 2017). Accordingly, customers are more likely to buy items with minimal consideration if retailers provide higher enjoyment during their shopping experience (Helmi et al., 2023). In a nutshell, hedonic values, such as the enjoyable and experiential aspects, significantly contribute as the Organism (O) in shaping customers' Response (R) to impulse buying (Yang et al., 2021). Building upon these explanations, the hypothesis is as follows:

H6: Hedonic value has a positive effect on customers' online impulse buying of makeup products

Furthermore, in the SOR model, AR characteristics act as external Stimulus (S) contributing to the user experience, whilst hedonic value (organism) represents the pleasure, excitement, and fun experienced during shopping influenced by these AR features (Hsu et al., 2021). Specifically, when AR features effectively stimulate users, they enhance their hedonic value, which in turn leads to customers' behavioral Responses (R) (Nikhashemi et al., 2021). Thus, it is expected that hedonic value plays a mediator in transforming the effects of AR characteristics into a more emotionally fulfilling and enjoyable experience, then leading to the behavioral response of impulse buying. Hence, the next hypothesis is proposed:

H7: Hedonic value mediates the relationship between AR characteristics (7a. interactivity, 7b. vividness, 7c. novelty, 7d. system quality and 7e. product informativeness) and online impulse buying

4. Research method

The quantitative method was employed in this study. Using a convenience sampling method, structured questionnaires were distributed to respondents in two ways: online surveys (via Google Forms) and paper-based surveys. The target respondents were Vietnamese women who have experienced AR features to try makeup products on e-commerce platforms.

A screening question was included at the start of the questionnaire to identify eligible participants for the study (i.e., "Have you ever used the AR feature on e-commerce platforms while searching for makeup cosmetics?"). The paper surveys were distributed in person to Vietnamese women at different locations, such as supermarkets, university campuses, shopping malls, and entertainment venues. These spots were chosen due to their high traffic, ensuring a broad reach of participants. Furthermore, the online questionnaires were shared via social media platforms and posted in online communities that focus on discussions related to online shopping and cosmetic products.

The measurement scales and their items in this study were adopted from previous studies, all formatted in a five-point Likert scale. To be more specific, the measurement scales of five AR characteristics, including interactivity (04 items), vividness (04 items), novelty (04 items), system quality (04 items), and product informativeness (04 items), as well as the hedonic value 4-item scale, were adopted from Gabriel et al. (2023). In addition, a 3-item scale for online impulse buying factor was borrowed from Kumar and Srivastava (2022). In total, there are seven factors with 27 items used in this research.

A qualitative and a quantitative preliminary study was conducted to adjust the original measurement scales for the online shopping context in Vietnam. The preliminary qualitative study involved face-to-face, in-depth interviews with five experts. Following this, a pilot study with a small sample of 42 respondents indicated that all measurement scales exhibited unidimensionality and reliability. The final questionnaire (including 07 measurement scales with 27 items) was used for collecting research data. In terms of sample size, Hair et al. (2019) suggested that models with seven constructs or less need at least a sample size of 150. In this study, 209 valid responses were collected and used for analysis, satisfying the requirement. The data was first cleaned, followed by the descriptive statistics analysis. Next, Exploratory Factor Analysis (EFA), Cronbach's Alpha, and Confirmatory Factor Analysis (CFA) were conducted to assess the measurement scales' validity and reliability. Finally, the research hypotheses were tested using Structural Equation Modeling (SEM). All analyses were carried out using SPSS and AMOS software.

5. Research findings

5.1. Sample characteristics

The data collected from 209 Vietnamese females revealed that the majority of respondents fall between 18 and 30 years old (72.2%). The significant presence of young participants in this study can be attributed to their relevance in the research context, as they are more familiar and actively engaged with AR technology compared to older participants. Most of the respondents have a university education level (62.7%), followed by 17.2% with an intermediate college education, 14.8% with high school or lower education, and a smaller percentage of 5.3% with post-graduate qualifications. Among these respondents, 40.7% have a monthly income under 05 million VND, 39.2% earn between 05 - 10 million VND, 15.8% earn between 10 - 20 million VND, and 4.3% earn between 20 to 30 million VND. Regarding their latest encounter with makeup products using AR on an e-commerce platform, 58.9% of respondents experienced lipstick, followed by foundation (16.3%), concealer (11.5%), and powder (7.2%). Additionally, descriptive statistics show that respondents engage with AR to buy makeup products on two platforms: Shopee (62.7%) and Lazada (37.3%). It can be explained that Shopee and Lazada are the two leading e-commerce platforms in Vietnam currently functioning with AR, allowing customers to virtually try on makeup products.

5.2. Scale assessment and refinement

First, Exploratory Factor Analysis (EFA) was conducted on each scale to evaluate its dimensional structure. The results indicated that all scales were unidimensional as designated. Then, the complete measurement model was estimated using Confirmatory Factor Analysis (CFA). **Table 1** below shows the result after eliminating 04 unsatisfactory items. Specifically, the estimation of the refined measurement model yielded satisfied fit indices, including Chi-square/df = 1.20 < 3; CFI = 0.98 > 0.9; TLI = 0.97 > 0.9; and RMSEA = 0.03 < 0.08 (Hair et al., 2019). The standardized factor loadings of the items ranged from 0.507 to 0.991 (> 0.5). The Average Variance Extracted (AVE) for each item was between 0.510 and 0.565, exceeding the 0.5 threshold. These results indicate that the measurement scales met the criteria for convergent validity. Additionally, the Composite Reliability (CR) for each scale ranged from 0.739 to 0.839, all of which were greater than 0.7, demonstrating satisfactory reliability (Hair et al., 2019).

Table 1

Summary of the Results of Measurement Scales Assessment

Constructs and items	**Std. factor loading**
Interactivity (CR = 0.793; AVE = 0.563)	
I have full control of the AR feature's navigation menu on the e-commerce platform	0.712
I have complete control over the available variations of makeup product X through the AR feature on the e-commerce platform	Eliminated in CFA
I have full control over the duration to see the makeup product X through the AR feature on the e-commerce platform	0.681
I can interact with virtual makeup product X displays through the AR feature on the e-commerce platform to get product-related information that fits my specific needs	0.848
Vividness (CR = 0.839; AVE = 0.565)	
I feel that the visual appearance of the makeup product X through the AR feature on the e-commerce platform is clear	0.769
I feel that the visual appearance of the makeup product X through the AR feature on the e-commerce platform looks without any blur or graininess	0.740
I feel that the visual appearance of the makeup product X through the AR feature on the e-commerce platform looks realistic	0.711
I feel that the visual appearance of the AR feature on the e-commerce platform is detailed	0.785
Novelty (CR = 0.780; AVE = 0.544)	
I feel that the AR feature on the e-commerce platform gives a new look to me the first time I try the makeup product X	Eliminated in CFA
I feel that the AR feature on the e-commerce platform gives a unique look to each variation of makeup product X	0.814

Constructs and items	Std. factor loading
I feel that the AR feature on the e-commerce platform makes a difference for each variation of makeup product X	0.727
I feel that the AR feature on the e-commerce platform shows something unusual for each variation of makeup product X	0.662
System Quality (CR = 0.739; AVE = 0.510)	
I feel that the AR feature on the e-commerce platform displays makeup product X visualizations quickly	0.540
I feel that the AR feature on the e-commerce platform can be relied upon to carry out its functions properly without any problems/errors in the system	Eliminated in CFA
I feel that the AR feature on the e-commerce platform is working for my purposes	0.991
I think that there are no problems using the AR feature on the e-commerce platform	0.507
Product Informativeness (CR = 0.806; AVE = 0.512)	
I get detailed information about makeup product X by using the AR feature on the e-commerce platform	0.799
I get complete information about makeup product X by using the AR feature on the e-commerce platform	0.755
I can make shopping decisions for makeup product X from the information I get when using the AR feature on the e-commerce platform	0.589
I can compare makeup product information with other makeup products when using the AR feature on an e-commerce platform	0.702
Hedonic Value (CR = 0.795; AVE = 0.564)	
I feel that e-commerce platforms equipped with AR features are more fun	0.715
I feel the time I spent using the virtual try-on feature of makeup product X on the e-commerce platform was a good thing	0.805
The virtual try-on feature on the e-commerce platform entertains me by seeing a new appearance of myself when trying makeup product X virtually	0.730
I feel happy when I use the virtual makeup try-on feature for product X on the e-commerce platform	Eliminated in CFA
Online Impulse Buying (CR = 0.774; AVE = 0.539)	
When I see makeup product X on an e-commerce platform with an AR feature, I have the idea of "buy now and think about it later"	0.586
When I see makeup product X on an e-commerce platform with an AR feature, I buy that product according to how I feel at the moment	0.729
When I see makeup product X on an e-commerce platform with an AR feature, I buy that product without thinking	0.862

Note. The data analysis result by the authors

In terms of discriminant validity, the correlation coefficient between each pair of constructs was less than the square root of AVE of the corresponding measurement scales (**Table 2**). This means that all scales met the criterion for discriminant validity (Fornell & Larcker, 1981).

Table 2

Discriminant Validity of the Measurement Scales

	INTER	VIVID	NOVEL	QUAL	INFOR	HEDO	IMPUL
INTER	**0.751**						
VIVID	0.414	**0.752**					
NOVEL	0.336	0.446	**0.738**				
QUAL	0.069	0.087	0.05	**0.714**			
INFOR	0.361	0.527	0.365	0.213	**0.716**		
HEDO	0.580	0.606	0.472	0.148	0.715	**0.751**	
IMPUL	0.383	0.378	0.272	0.195	0.413	0.630	**0.734**

Note. + Values in the lower triangular region represent the correlation coefficients
+ Values (in bold) in the diagonal represent the square root of Average Variance Extracted (AVE). The data analysis result by the authors

5.3. Structural model estimation and hypothesis testing

In this section, the research model was assessed by the CB-SEM method using Amos software. All model fit indices were achieved, including Chi-square/df = 1.68 < 3; TLI = 0.91 > 0.9; CFI = 0.92 > 0.9; RMSEA = 0.06 < 0.08 (Hair et al., 2019). **Table 3** illustrates the hypothesis testing results. In general, all hypotheses were supported at $p < 0.05$, except for the impact of system quality on hedonic value ($p = 0.466 > 0.05$). To be more specific, interactivity ($\beta = 0.377$, $p = 0.000$), vividness ($\beta = 0.291$, $p = 0.000$), novelty ($\beta = 0.163$, $p = 0.027$), product informativeness ($\beta = 0.538$, $p = 0.000$) have a positive effect on Hedonic value. In addition, hedonic value demonstrates a significant positive effect on online impulse buying ($\beta = 0.567$, $p = 0.000$). The results also indicate that the AR characteristics can explain 54.4% of the variance of hedonic value, and hedonic value predicts 32.2% of the variance of online impulse buying.

Table 3

Structural Model Estimation and Hypothesis Testing Results

Hypothesis		Std. coeff.	*p*-value	Test result
H1 (+)	Interactivity → Hedonic Value	0.377	0.000	Supported
H2 (+)	Vividness → Hedonic Value	0.291	0.000	Supported
H3 (+)	Novelty → Hedonic Value	0.163	0.027	Supported
H4 (+)	System Quality → Hedonic Value	-	0.466	Not supported
H5 (+)	Product Informativeness → Hedonic Value	0.538	0.000	Supported
H6 (+)	Hedonic Value → Online Impulse Buying	0.567	0.000	Supported

Note. The data analysis result by the authors

Additionally, the study examined whether hedonic value mediates the effect of AR characteristics on online impulse buying (H7). Using AMOS software, the bootstrap simulations (N = 1,000) were performed to estimate the mediating effect. Additionally, the direct relations between AR characteristics and impulse buying were added to the research model to test whether they are significant when hedonic value plays as the mediator. The model fit indices were acceptable, including Chi-square/df = 1.70 < 3; TLI = 0.90 ≥ 0.9; CFI = 0.91 > 0.9; RMSEA = 0.06 < 0.08. **Table 4** presents the finding that there are indirect effects of AR characteristics (interactivity, vividness, novelty, product informativeness) on online impulse buying ($p < 0.05$). Furthermore, with the existence of hedonic values in these relationships, the direct effects of AR characteristics on online impulse buying are insignificant ($p > 0.05$). This means that hedonic value plays a perfect mediating role in the relationships of AR characteristics, with the exception of system quality, on customers' online impulse buying of makeup products.

Table 4

The Indirect Effects of AR Characteristics on Online Impulse Buying

Indirect effect (The mediating role of hedonic values)	**Std. coeff.**	***P*-value**	**Test result**
H7a: Interactivity → Hedonic values → Online impulse buying	0.222	0.001	Supported
H7b: Vividness → Hedonic values → Online impulse buying	0.175	0.002	Supported
H7c: Novelty → Hedonic values → Online impulse buying	0.101	0.047	Supported
H7d: System Quality → Hedonic values → Online impulse buying	-	0.650	Not supported
H7e: Product Informativeness → Hedonic values → Online impulse buying	0.333	0.002	Supported
Direct effect	**Std. coeff.**	***p*-value**	**Test result**
Interactivity → Online impulse buying	-	0.724	Not supported
Vividness → Online impulse buying	-	0.959	Not supported
Novelty → Online impulse buying	-	0.811	Not supported
System Quality → Online impulse buying	-	0.157	Not supported
Product Informativeness → Online impulse buying	-	0.549	Not supported

Note. The data analysis result by the authors

5.4. Discussion

Based on the SOR model, this research examined the impact of AR characteristics on hedonic value and then the influence of hedonic value on online impulse buying. The findings of this study indicate that all hypotheses are supported, except for the relationship between AR system quality and hedonic value. Specifically, four AR characteristics of *interactivity, vividness, novelty, and product informativeness* have significant positive effects

on customers' hedonic value. Moreover, hedonic value has been proven to play a vital role in enhancing online impulse buying. Finally, this research also indicates the perfect mediating role of hedonic value in the relations between the four mentioned AR characteristics on customers' impulse buying in online platforms.

Among these factors, *product informativeness* in AR emerges as the most influential factor in enhancing customers' hedonic value. While this finding contradicts the research by Gabriel et al. (2023), but is consistent with Hsu et al. (2021). This AR characteristic provides users with detailed product information through the virtual display. This goes beyond normal online shopping, meeting customers' increasing desire for content, knowledge, and interactive experiences when shopping online on e-commerce platforms (Mai, 2023). Traditionally, online shoppers need to imagine the appearance of makeup products based on provided media, sometimes leading to wrong information gained. However, AR features on e-commerce platforms can help customers see how the product is displayed directly on their own faces instead of relying solely on their imagination, hence providing more detailed and exact product information (Gabriel et al., 2023; McLean & Wilson, 2019).

Next, *AR interactivity* has a positive effect on hedonic values. This finding aligns with previous studies by Gabriel et al. (2023), Kumar et al. (2023). The AR characteristics of interactivity offer hedonic value to customers during their virtual try-on experiences. Similarly, Gabriel et al. (2023) noted that customers perceive interactivity in terms of the entertainment and pleasure they derive from it, with interactive AR experiences leading to an increased level of pleasure for customers. This interactive experience satisfies users' desire to explore further, thereby enhancing their enjoyment of the overall experience.

In addition, *AR vividness* also has a positive effect on hedonic values. It ensures the clear, realistic visualization of these virtual makeup products, thereby bridging the gap between online and offline shopping experiences. This finding differs from that of Gabriel et al. (2023). It can be explained that Vietnamese customers highly value AR technology on e-commerce platforms for offering realistic beauty product experiences without needing to visit a physical store (Vu Phong, 2022). Moreover, when conducting interviews with experts in this study, they emphasized the balance between vividness and realism as an important thing that they appreciate when using AR on e-commerce platforms, which ensures that users have immersive experiences that feel genuine and realistic to increase their enjoyment.

Novelty has a positive effect on hedonic values. This result aligns with that of Gabriel et al. (2023). The AR novelty provides a new, unique, and personalized makeup look to users. While using the virtual try-on feature, AR novelty offers advantages to customers, such as time-saving in product search and facilitating quick and efficient purchases. Especially, it allows customers to explore various makeup styles and virtual products without the need for physical application, significantly enhancing their overall enjoyment.

In contrast, the effect of AR system quality on customers' hedonic value is not supported in this study. This result is also consistent with the study by Gabriel et al. (2023). This finding can be explained by the fact that AR system quality itself may not be a factor directly triggering enjoyment, but it plays an initial foundation in creating an immersive environment for customer experiences. Therefore, customers may take the system quality for granted and not be easily impressed. In a nutshell, system quality is a necessary condition for system operation. It should be guaranteed to ensure customers' experience but does not increase their hedonic value.

Furthermore, the customers' *hedonic value* has been found to positively influence their *online impulse buying* behavior, which is consistent with the findings of Kumar and Srivastava (2022). Compared to usual online product interactions via other technologies, AR try-on experiences offer a different way for customers to personalize their visualization and interaction with products, thereby triggering more positive emotions such as joy and excitement. Notably, customers are now more willing to embrace new technology, have preferences for dynamic and multifaceted experiences, and their purchase decisions are easily influenced by their emotions (Pluta-Olearnik & Szulga, 2022). Thus, the positive emotions gained through this AR experience can reduce customers' hesitation and encourage them to promptly own the product.

This study further highlights the mediating role of hedonic value in fully explaining the relationship between Augmented Reality (AR) characteristics and online impulse buying behavior. While some prior studies examined the effects of AR features, and/or hedonic value on customers' behaviors (Hsu et al., 2021; Whang et al., 2021; Yang, 2021). There have been limited studies indicating the mediating role of hedonic value on AR and buying behaviors relationship, especially online impulse buying (Vieira et al., 2022). Therefore, this finding contributes to the reinforcement of the Stimulus-Organism-Response (SOR) model, wherein the stimuli (AR features) influence consumer purchasing behavior through the mechanism of enhancing the hedonic value in the shopping experience on e-commerce platforms.

6. Managerial implication and conclusion

This research demonstrates how AR influences customers' hedonic values and how these values trigger impulse buying of makeup products on e-commerce platforms in the current Vietnamese context. Based on the findings, businesses that have their online store on e-commerce platforms, AR-equipped e-commerce platforms, and even those intending to use AR can improve and develop suitable strategies to effectively leverage customers' online impulse buying when shopping for makeup products through AR. Especially, the research highlights the crucial impact of hedonic values in the online shopping experience on boosting customer purchasing behavior.

To enhance customers' hedonic values, it is essential to improve four aspects of AR: product informativeness, interactivity, vividness, and novelty, which ensures enjoyment is increased when shopping. Firstly, in relation to product informativeness, managers should understand what additional information customers need about the makeup products that the current AR feature does not provide ineffectively, such as finish (matte, dewy, satin), coverage (sheer, medium, full), and key benefits (hydration, long-lasting wear, oil control). Moreover, it is important to optimize the visualization to better align with customers' needs. AR design should prioritize user-friendliness in interactivity so that everyone can use it easily. In addition, AR filters should have higher resolution, more vibrant colors, and sharper details. Simultaneously, it is necessary to balance vividness and the realistic representation of virtual and actual products. To achieve this, AR technical developers need to enhance the display quality of AR by focusing on improving image clarity, minimizing errors, and ensuring adaptability and responsiveness across various users' environments and lighting conditions. Finally, businesses should enhance AR novelty and individualization in presenting each virtual product to every user. Specifically, AR filters should adjust each product presentation based on individual characteristics, ensuring that product differences and variations are displayed uniquely while highlighting each person's distinct facial contours. In summary, the

enhancement could potentially encourage customers to "try on" products through AR and make purchases with little hesitation.

Although this research has provided meaningful findings, it still has limitations. Firstly, the findings may not apply to all kinds of products, which only focused on makeup products using AR. Thus, further research could explore the impact of AR applications in a wider range of e-commerce sectors beyond makeup, such as fashion or skincare products, where AR is currently used for more useful analysis and recommendations for customers. Additionally, expanding the scope to collect data in various regions would provide various experimental findings on how diverse demographics and geographical attributes influence customers buying behaviors on e-commerce platforms. Secondly, besides five AR characteristics, further effort should be made to explore more factors that impact customers' hedonic values in the online shopping context to contribute a more comprehensive understanding of this field. Finally, convenience sampling is a non-probability sampling method, making it less reliable for generalizing the results to the population. Future research should consider using probability sampling methods to gain more accurate insights and enhance the generalizability of the findings.

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NO CONFLICT OF INTEREST STATEMENT

All authors declare that they have no conflict of interest.

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