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Article

The influence of augmented reality on E-commerce: A case study on fashion and beauty products

Cogent Business & Management

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Suggested Citation: Gabriel, Adelya; Ajriya, Alina Dhifan; Fahmi, Cut Zahra Nabila; Handayani, Putu Wuri (2023) : The influence of augmented reality on E-commerce: A case study on fashion and beauty products, Cogent Business & Management, ISSN 2331-1975, Taylor & Francis, Abingdon, Vol. 10, Iss. 2, pp. 1-20,
<https://doi.org/10.1080/23311975.2023.2208716>

This Version is available at:

<https://hdl.handle.net/10419/294418>

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To cite this article: Adelya Gabriel, Alina Dhifan Ajriya, Cut Zahra Nabila Fahmi & Putu Wuri Handayani (2023) The influence of augmented reality on E-commerce: A case study on fashion and beauty products, Cogent Business & Management, 10:2, 2208716, DOI: [10.1080/23311975.2023.2208716](https://doi.org/10.1080/23311975.2023.2208716)

To link to this article: <https://doi.org/10.1080/23311975.2023.2208716>



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Published online: 17 May 2023.



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Received: 08 January 2023
Accepted: 26 April 2023

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Reviewing editor:
Balan Sundarakani, University of Wollongong Faculty of Business, United Arab Emirates

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INFORMATION & TECHNOLOGY MANAGEMENT | RESEARCH ARTICLE

The influence of augmented reality on E-commerce: A case study on fashion and beauty products

Adelya Gabriel¹, Alina Dhifan Ajriya¹, Cut Zahra Nabila Fahmi¹ and Putu Wuri Handayani^{1*}

Abstract: Advances in technology have encouraged people in Indonesia to shop online. Apart from the convenience people feel when shopping online, there are still disadvantages that prevent them from trying the products they will buy. Therefore, a virtual try-on feature based on augmented reality (AR) could be a solution. This study aims to determine the effect of implementing AR on beauty and fashion products on the intention to continue using AR and shopping in e-commerce. The design of this research model is based on the Stimulus, Organism, Response (SOR) theory used to investigate research factors using AR characteristics. This study used a covariance-based structural equation modeling method. This study involved 549 respondents and demonstrated that interactivity, novelty, hedonic value and satisfaction significantly affect continuance intention. In addition, AR continuance intention also had a significant effect on purchase intention. The results of this research are also expected to be input for e-commerce service providers and AR developers to improve services for users to shop online. This study contributes to extending SOR theory to the context of AR characteristics.

Subjects: Internet & Multimedia - Computing & IT; Consumer Psychology; Information Technology

Keywords: augmented reality; virtual try-on; fashion and beauty products; e-commerce; continuance intention; purchase intention; Indonesia

1. Introduction

The development of technology and the Internet in the digital era has made it easier for people to carry out various activities online through digital devices such as smartphones (S.H. -Y. Hsu et al., 2021). Smartphone users in Indonesia currently reach 370.1 million people (Akdim et al., 2022). In addition, internet use increased annually until it reached 73.7% of the population in early 2022, approximately 202.6 million users (We Are Social, 2022). With the high number of internet users in Indonesia coupled with the COVID-19 pandemic, it is undeniable that these two things have affected people's behavior, which has also changed to become completely digital from what was originally traditional (Sohn, 2017).

The COVID-19 pandemic also increased the e-commerce industry, so business developers had to be more adaptive in creating various strategies to continue attracting people to purchase online (Media, 2021). To keep up with existing technological developments, e-commerce must also

quickly adapt to and keep pace with technological developments, namely by utilizing AR technology (Kowalczyk et al., 2020). AR utilizes visual technology, and users will get new experiences from using this technology (S.H. -Y. Hsu et al., 2021). The combination of interactions between the real world and the virtual world utilized by AR makes users feel the information displayed in real time seems interactive and real and integrates adaptive content (Vieira et al., 2022). Users often cannot decide to purchase a product because they do not know how it performs until they purchase and use it. Previous research has found that AR allows users to be able to see products from different angles and see products in various shapes and colors on virtual models to match the appearance they want (J. Kim & Forsythe, 2008) and can also make decisions to purchase without any hesitation (Arghashi, 2022). In addition, the presence of AR can trigger deeper user involvement (Nikhashemi et al., 2021). Impressions and memories that users feel are generated from their experiences (S.H. -Y. Hsu et al., 2021). Therefore, AR aims to provide services that allow users to process information naturally to feel they are using the product (Vieira et al., 2022).

The application of AR in e-commerce aims to provide choices for e-commerce to display product presentations and to be able to improve the experience felt by users (Kowalczyk et al., 2020). AR is also used as an innovative medium by e-commerce to integrate virtual things into real versions (Rauschnabel et al., 2019). The presence of AR is one of the innovations in media marketing that can be applied by e-commerce to attract more specific users (Arghashi, 2022). The use of AR increased yearly, not only in Indonesia but almost all over the world during 2017–2021 (Yim et al., 2017).

The application of AR in e-commerce can add an even better experience and value to users (Nikhashemi et al., 2021). The experience and perceived value are influenced by several AR characteristics that influence user behavior in using e-commerce, especially on the intention to continue using e-commerce (Butt et al., 2021; Nikhashemi et al., 2021; S.H. -Y. Hsu et al., 2021). This is emphasized again when virtual product trials create enchanting experiences through AR aspects and AI context-specific variables (Butt et al., 2021).

The application of AR in e-commerce increases the value of e-commerce itself, especially in terms of user personalization with self-service (Alimamy & Gnoth, 2022). Users can interact directly with the application to try products sold with the help of AR, so that users can see how they look when using these products (Butt et al., 2021). In other words, AR applied to e-commerce can influence users' shopping intentions for its products (Nikhashemi et al., 2021). Previous studies have found that the most important thing for users when trying virtual products is the accuracy of the virtual content of the products they try (Y. Wang et al., 2021). In beauty products, what matters the most is the accuracy of the color displayed from the original product, so that users rely on the AR feature to determine their intention to buy the product (Y. Wang et al., 2021).

Many studies have found that AR's characteristics as a stimulus positively impact purchase intentions and sustainability intentions as separate responses. However, Scholz and Duffy (2018) found that AR affects users' intention to continue using mobile games. In general, many studies have discussed AR in its application in e-commerce, but it is still limited to China, South Korea, Malaysia, and Taiwan (Butt et al., 2021; Nikhashemi et al., 2021; S.H. -Y. Hsu et al., 2021). Previous research has shown that each country has different demographic compositions and characteristics. Different settings of mobile AR use and culture have different expressions of user experience values (S.H. -Y. Hsu et al., 2021).

Previous research has also examined several e-commerce sites with different AR features or applications and a different product focus being tried virtually. However, some of the applications studied are not available in Indonesia, namely the YouCam application, which is only available in Taiwan (S.H. -Y. Hsu et al., 2021) and Amazon (Nikhashemi et al., 2021). In addition, not all previous studies focused on beauty products, but also non-beauty products (Nikhashemi et al., 2021). By adding product variations, it is possible to obtain more varied demographics and will

increase research results that are more generalized and reduce bias (Watson et al., 2018). This study not only focuses on beauty products but also fashion products. Thus, the research question is: How does the implementation of AR affect fashion and beauty products on the intention to continue using features and shop in e-commerce? This research can help AR developers, especially in e-commerce, find out what factors contribute significantly to the intention of users to continue using the virtual try-on feature or shopping in e-commerce. Finally, e-commerce in Indonesia can start implementing or improving the quality of its services, especially in the virtual try-on feature, to contribute to the development of e-commerce in Indonesia in terms of the number of users and product purchases.

2. Literature review and hypothesis

2.1. Augmented reality virtual try-on

Augmented reality (AR) is an interactive tool that combines real and virtual worlds by modifying the original environment with virtual elements (Smink et al., 2019). It is not the intent of AR to replace the real world. However, AR adds a display that the user sees with a visual display when using AR in the real world (Yim et al., 2017). Nikhashemi et al. (2021) found that research related to AR must explain and determine the characteristics of AR that will be used later. The AR system was created in the 1960s and initiated by Ivan Sutherland (Hung et al., 2021). The AR virtual try-on can make consumers feel like they are using the product (Vieira et al., 2022). The use of AR virtual try-on in an application requires a camera to take pictures, which will later be combined with the information you want to display and then displayed simultaneously on the user's screen (Hung et al., 2021).

In e-commerce, AR virtual try-on is an advantageous feature for e-commerce today (Whang et al., 2021) because AR virtual try-on is a transformative visual technology that can add immersive reality-related experiences during the buying process (S.H. -Y. Hsu et al., 2021). AR virtual try-on is an innovation used by e-commerce to display products online (Plotkina & Saurel, 2019). This allows users to assess the product's suitability on their bodies (Yim & Park, 2019). In addition, users will also have more trust in the products displayed using AR virtual try-on (Yim & Park, 2019). Products displayed using AR virtual try-on are interactive (Hung et al., 2021; Smink et al., 2019) and allow the display of products in real time (Plotkina & Saurel, 2019; Smink et al., 2019). AR virtual try-on can also create three-dimensional space (Hung et al., 2021), allowing users to use products virtually through physical movement. An example is displaying products through facial recognition, such as makeup and eyewear products (Smink et al., 2019).

2.2. Stimuli, Organism, and Responses (SOR)

The Stimulus Organism Response (SOR) model forms the basis of this research. This theory was first proposed by environmental psychologists Mehrabian and Russell (1974). The SOR model is said to be a stimulus generated by the environment that affects the user's internal response, thereby creating cognitive and emotional responses (pleasure, arousal, domination, etc.) and affecting their decisions, such as approach or rejection (Errajaa et al., 2022; Nikhashemi et al., 2021). Arghashi (2022), Y. Wang et al. (2021), Nikhashemi et al. (2021), and Sengupta and Cao (2022) confirmed that the SOR model is suitable for investigating stimulus factors using AR characteristics.

In the SOR model, there are three basic divisions in the online consumer experience: stimulus (S), organism (O) and response (R) (Y. Wang et al., 2021). Stimulus or stimuli are factors that can influence individual responses. Organism is an internal structure that links external stimuli to customers, ultimately affecting the final response (Sengupta & Cao, 2022). Response is the psychological reaction and behavior (Mehrabian & Russell, 1974). The variable used as a response in this study is the user's intention to make a purchase.

2.3. Conceptual model

We designed this research model using the SOR framework. This framework was selected based on previous studies examining the causation of AR implementation on continuance and shopping

intentions (Nikhashemi et al., 2021; S.H. -Y. Hsu et al., 2021); this framework has been used previously to research the same topic. S.H. -Y. Hsu et al. (2021) said that the SOR paradigm has recently been used to identify various influences of AR features or applications on user behavior, where AR app characteristics serve as a research stimulus. We also compared other theories that were implemented in research related to AR conducted by Vieira et al. (2022), namely, the technology acceptance model (TAM) and the unified theory of acceptance and use of technology (UTAUT). However, these theories have objectives that are inconsistent with the research in which the two theories focus on analyzing the factors that influence the acceptance of a system. In contrast, this research aims to identify how AR can affect users' behavioral intentions. Research has also suggested a model design for future research to better understand AR and help e-commerce develop AR to impact both sales and the use of its features and applications (Watson et al., 2018).

The Stimulus (S) component of the model focuses on five characteristics of AR: interactivity, vividness, novelty, system quality, and product informativeness. These characteristics are summarized below.

- *Interactivity* focuses on how users of virtual try-on can control the form of the visual results of the physical user in the real world combined with additional virtual content in the form of product visualization when used by users (Kowalczyk et al., 2020; McLean & Wilson, 2019).
- *Vividness* is one of the characteristics that will be examined to see how good and clear the visualization of products currently provided by AR is in the eyes of its users (McLean & Wilson, 2019). Butt et al. (2021) also suggested further research to be able to add other variables to better understand from the perspective of consumer behavior using AR. One of them is vividness.
- *Novelty* indicates how well the virtual try-on features that currently exist in e-commerce make users feel like they see themselves with a personalized and new look for them (McLean & Wilson, 2019).
- *System Quality* measures the system's functionality which plays a role in meeting user needs in trying products without any problems (Kowalczyk et al., 2020).
- *Product Informativeness* determines how effectively the information provided through AR fulfill users' needs; this ultimately determines or influences their intention to buy the beauty or fashion products they desire (Kowalczyk et al., 2020).

Previous research was still limited in selecting factors influencing the continuing intention to use AR. S.H. -Y. Hsu et al. (2021) suggested including other factors, such as system quality and novelty, in the research. These five characteristics have been tested in previous research to influence the variables of sustainability and shopping intentions.

The Organism (O) of the model consists of two characteristics: hedonic value and satisfaction. Hedonic value refers to the value users create in seeking pleasure and satisfaction from an activity. It is known in research (Vieira et al., 2022) that the hedonic value variable has a positive influence on the satisfaction felt by users when using AR. Hedonic values are subjective judgments and are more personal than utilitarian values (S.H. -Y. Hsu et al., 2021). In the context of this study, the hedonic value variable is the happy feelings felt by users when using virtual try-on in e-commerce.

Another variable adapted into the research model was satisfaction. Satisfaction is the feeling of satisfaction resulting from the fulfillment of expectations (Gruen, 1995). We selected this variable because user satisfaction influences behavioral intention (Vieira et al., 2022).

The Response (R) component of the model consists of two characteristics: purchase intention and continuance intention. The last variable adopted in this study was purchase intention. This variable was used in a study by Vieira et al. (2022) and Y. Wang et al. (2021). Purchase intention is a desire owned by consumers and has the potential to lead to product purchases (Y. Wang et al., 2021). Knowing the desires of consumers can maintain communication between consumers and brands (in the context of this research, e-commerce). The second variable adapted was

continuance intention. This variable was used in a study by Scholz and Duffy (2018). We chose this variable to be adopted because previous studies explained that a high continuance intention would affect long-term success (Scholz & Duffy, 2018).

Based on the theory and factors above, this research model was designed with five exogenous variables: interactivity, vividness, novelty, system quality, and product informativeness as Stimulus (S). This research model also has two endogenous variables: hedonic value and satisfaction as internal cognition or state of the Organism (O) and continuance intention and purchase intention as a behavioral Response (R). The conceptual model proposed for this research is shown in Figure 1.

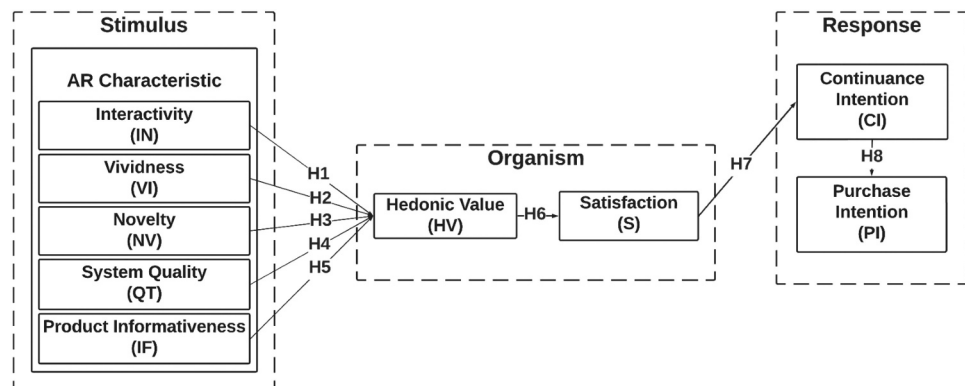
Interactivity is one of the primary features of AR technology (Butt et al., 2021). According to Butt et al. (2021), the main points that define interactivity are responses and reactions that occur in the real world or the surrounding environment, which are mediated in real time. Meanwhile, according to S.H. -Y. Hsu et al. (2021), interactivity is the extent to which AR features allow users to operate product content in applications and interact with the available interface designs (S.H. -Y. Hsu et al., 2021). When it comes to the use of AR, research conducted by C. -L. Hsu et al. (2011) found that applications that utilize AR are supposed to provide a fun and entertaining experience. Previous studies have also proven that interactivity positively affects hedonic value (Nikhashemi et al., 2021; Tam & Ho, 2006). Yim et al. (2017) proved that interactivity significantly influences media enjoyment. Therefore, we propose the following hypothesis:

H1: *Interactivity (IN) influences hedonic value (HV).*

In the context of e-commerce, vividness is often associated with the quality of product presentation. Yim et al. (2017). The original embodiment of the product is always imagined by users when they want to buy products online, but now with AR, users no longer need to imagine the product in their heads (McLean & Wilson, 2019). McLean and Wilson (2019) say that vividness is an essential factor in influencing an individual’s level of enjoyment. This is also supported by the results of this study, which prove that vividness has a positive effect on hedonic values (McLean & Wilson, 2019; Nikhashemi et al., 2021). Yim et al. (2017) also proved that vividness mediated by immersion affects media enjoyment. Therefore, we propose the following hypothesis:

H2: *Vividness (VI) influences hedonic value (HV).*

Figure 1. Proposed conceptual model.



Novelty refers to new stimuli that the user receives as unique, unusual, or personal (Arghashi, 2022). Based on C. -L. Hsu and Lin (2016), novelty can be triggered by stimuli in the form of product visual displays through AR features. The product's visual appearance allows users to place and see the product directly on themselves and make it something new and personal (Arghashi, 2022). In addition, users can operate personalized options according to the style or way they prefer. This will directly affect the creation of a pleasant and satisfying experience for everyone (HV). In other words, the HV that users experience is influenced by personalized AR features (S.H. -Y. Hsu et al., 2021). Thus, we propose the following hypothesis:

H3: *Novelty (NV) influences hedonic value (HV).*

System quality in AR includes all constructs that address how accurate and reliable AR is so that it provides the requested service (Kowalczyk et al., 2020). System quality is the users' ease of virtually identifying, processing, and understanding features. One of the critical predictors of user satisfaction with services is system quality, which indicates that the system must offer quick responses to user questions simultaneously (Ashfaq et al., 2020). Further research has also found that the shopping experience that consumers feel when using AR has the same taste as the real shopping experience (Nikhashemi et al., 2021). The shopping experience is an essential factor, so according to Sohn (2017), the technical and functional quality of the system in an online store must be of high quality because it will make the product presentation work well (Kowalczyk et al., 2020). Nikhashemi et al. (2021) found that enjoyment (hedonic benefits) could be obtained from user experiences. Therefore, we propose the following hypothesis:

H4: *System quality (QT) influences hedonic value (HV).*

Product informativeness can be interpreted as the extent to which a product displayed online can provide product-related information that can help buyers obtain satisfaction in choosing the product or service (Kowalczyk et al., 2020; Vieira et al., 2022). Poushneh (2018) argues that making consumers feel the same experience when shopping online is one of the roles of AR, namely, by presenting information that utilizes a combination of virtual and reality (Kowalczyk et al., 2020). C. -L. Hsu et al. (2011) and S.H. -Y. Hsu et al. (2021) found that AR applications on mobile phones are useful because of the information they provide in the application. S.H. -Y. Hsu et al. (2021) proposed that informativeness is directly related to the pleasure consumers feel, which is one of the criteria for HV. Information packaged attractively increases HV (S.H. -Y. Hsu et al., 2021). Therefore, we propose the following hypothesis:

H5: *Product informativeness (IF) influences hedonic value (HV).*

Hedonic value is influenced by an increase in pleasant experiences felt by users (C. -L. Hsu & Lin, 2016). The level of pleasure that customers feel when using an application can be stimulated by AR features that have functions of sensory stimulation, fantasy, fun, and entertainment (S.H. -Y. Hsu et al., 2021). In the theory of motivation, it is stated that hedonic value is intrinsic motivation. Intrinsic motivation focuses on the satisfaction and pleasure felt by users who are obtained from carrying out a specific behavior (C. -L. Hsu & Lin, 2016). The value felt by the user is a driving force in achieving customer satisfaction. The use of AR affects the hedonic value felt by users. Therefore, this will affect customer attitude responses, such as attitudes and satisfaction (Vieira et al., 2022). Previous research has stated that hedonic values and satisfaction have a direct relationship (C. -L. Hsu & Lin, 2016). Thus, we define the following hypothesis:

H6: *Hedonic value (HV) influences satisfaction (ST).*

Satisfaction is a response that is generally a cognitive or emotional response that occurs when an individual has performed an activity, where the level of satisfaction is determined by how much the activity meets expectations, expectations, needs, and others (Ashfaq et al., 2019). Satisfaction is considered an essential factor in the field of marketing and technology. AR uses satisfaction to find out how much user satisfaction is with technology, which is currently still being developed and implemented in various fields (Butt et al., 2021). Previous research has also proven that satisfaction is a reliable factor and has a positive relationship with purchase attitude, where there is continuance intention (Ashfaq et al., 2019). Ashfaq et al. (2020) said that increased user satisfaction with using technology leads to a higher level of continuance intention in using technology, namely AR. Therefore, we propose the following hypothesis:

H7: *Satisfaction (ST) influences continuance intention (CI).*

A study conducted by Kowalczyk et al. (2020) found that advantages can be gained from implementing AR by providing product presentations that affect customer behavioral responses, such as reusing features from user purchase intentions. These advantages are obtained from AR features that can create a pleasant customer experience and influence positive behavioral responses (Nikhashemi et al., 2021). This is supported by K. Kim et al. (2014), who found that AR smartphone applications directly affect sustainability intentions. In addition, the application of AR in e-commerce allows users to obtain more information about products and leads to increased intention to make purchases (Scholz & Duffy, 2018). Purchase or buying behavior can be seen as a deeper level of user commitment to the service platform experience (Scholz & Duffy, 2018). Thus, we suggest the following hypothesis:

H8: *Continuance intention (CI) influences purchase intention (PI).*

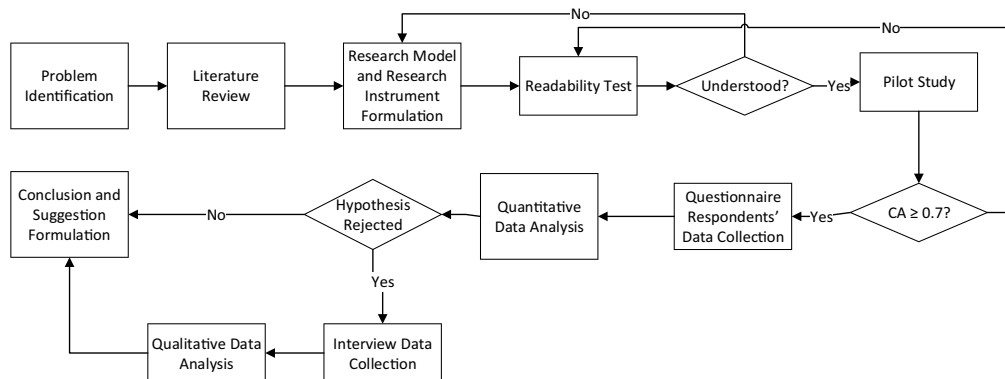
3. Materials and methods

3.1. Data collection

The stages of this research include problem identification, literature review, research model and research instrument formulation, readability test, pilot study, quantitative and qualitative data collection, data analysis, and conclusion and suggestion formulation. Figure 2 describes the detailed flow of the research methods. The target respondents of this research questionnaire were Indonesian people over 17 years old who have tried makeup and fashion products online and virtual try-on features on e-commerce that provide them, such as Shopee, JD.ID, Saturdays, Sephora, Lazada, and others. Before collecting the quantitative data, we conducted a readability test and a pilot study. The readability test stage was conducted to determine the questionnaire questions' quality and validity and ensure the respondents correctly understood the instructions. The author will later use the results of this readability test to improve the questionnaire questions so that all respondents can more easily understand them. The readability test was conducted by interviewing 11 respondents.

Purposive sampling was used to obtain respondents for the readability test and pilot study. This method was chosen because it has proven effective in achieving maximum variability in primary data (Black, 2010). After the suggestions from the readability test respondents have been collected, the questions will be revised based on these suggestions to produce the final questionnaire questions. Furthermore, the questionnaire questions will be tested during the pilot study stage. The pilot study aimed to test the reliability of the research instrument and was conducted by distributing the research questionnaires to 32 respondents. The research instrument is reliable if

Figure 2. Research methods.



Cronbach's alpha is above 0.7 (Hair et al., 2019). In this study, the Cronbach's alpha (CA) was 0.959; based on the previous explanation, this instrument can be reliable and carry out further research.

The online questionnaire was disseminated through social media applications such as LINE, Instagram, Twitter, WhatsApp, and TikTok. In addition, we provide incentives with a total of IDR 300,000.00 for six randomly selected respondents. Data collection was carried out for over one month, starting from 19 September 2022 to 26 October 2022, with 549 valid data obtained. Respondent data were valid if the respondent filled in all parts of the questions in the questionnaire. A summary of the respondents' demographic data is shown in Table 1.

3.2. Analysis methods

This stage was carried out using the covariance-based structural equation modeling (CB-SEM) method, with the help of the AMOS 26 program. CB-SEM was used to test research theories proven in previous studies. CB-SEM generally includes the measurement, structural, and hypothesis test stages. After the quantitative data analysis by conducting hypothesis testing using CB-SEM was completed, it was found that several hypotheses proposed in this study were rejected. Therefore, it is necessary to carry out an in-depth analysis with additional qualitative data collected from 15 respondents during the interview stage. The respondents were in the range of 20–35 years. In addition, 10 respondents lived in Greater Jakarta, and the remaining lived in Java. The stages of the interview process included the following:

- (1) Preparing interview questions that focus on indicators related to the rejected hypothesis.
- (2) Selecting respondents according to the previously mentioned criteria.
- (3) Contacting respondents for availability to attend interviews.
- (4) Conducting interviews with willing respondents who meet the interview respondent criteria mentioned earlier.

The process was carried out online via email and WhatsApp to contact respondents and Google meet for the interview process. The interviews were conducted in approximately two weeks, from November 2 to 16 November 2022.

In addition, content analysis is used to analyze the qualitative data that has been obtained. Interpreting these qualitative data was used to find more detailed reasons for the research hypothesis being rejected. These results were used as primary data to support the reasons for a hypothesis previously tested through quantitative data being rejected in this study. In this qualitative data analysis, suggestions or input were also obtained for developing AR, especially for implementing virtual try-on features for e-commerce that have these features.

Table 1. Respondents' demographics

Demographics		Number of Respondents	Percentage
Gender	Men	154	28.1%
	Women	395	71.9%
Age	>45 years old	3	0.5%
	17-25 years old	352	64.1%
	26-35 years old	188	34.2%
	36-45 years old	6	1.1%
Domicile	Aceh	1	0.2%
	Bali/NTT/NTB	48	8.7%
	Greater Jakarta	273	49.7%
	Jawa (Non-Greater Jakarta)	193	35.2%
	Kalimantan	3	0.5%
	Sulawesi	2	0.4%
	Sumatera	29	5.3%
What e-commerce is used to use the virtual try-on feature?	Shopee	255	33.33%
	JD.ID	5	0.65%
	Saturdays	187	24.44%
	Sephora	80	10.46%
	Lazada	42	5.49%
	Lainnya	196	25.62%
What products have you tried using the virtual try-on feature in e-commerce?	<i>Fashion</i> (eyeglasses)	191	33.4%
	Makeup (lipstick, blush, etc.)	381	66.6%

3.3. Research instruments

The 36 questions focused on demographics, validation, and measurement. The questionnaire uses an ordinal Likert scale ranging from 1 (strongly disagree) to a scale of 5 (strongly agree). Details of each research instrument are explained in [Appendix A](#) [Appendix B](#) describes the interview instruments.

4. Results

4.1. Measurement and structural models

The validity test was carried out using the average variance extracted (AVE) test. The test was declared passed if the AVE value of each latent variable in the study met the requirements, namely, $AVE \geq 0.50$ (Hair et al., 2019; Scholz & Duffy, 2018). The reliability test used two assessment indicators: composite reliability (CR) and CA. In the reliability test, the requirements for a measurement model to pass the test were CR value ≥ 0.7 and CA ≥ 0.7 (Hair et al., 2019). Table 2 shows the CR, CA, and AVE values.

Next, a goodness-of-fit (GoF) was evaluated to assess the validity of the measurement model by evaluating the GoF and construct validity (Ashfaq et al., 2020). The evaluation proceeded to the structural model test stage if it was complete. In this measurement model, the value components of GoF evaluated were CMIN/df, RMSEA, normal fit index (NFI), comparative fit index (CFI), goodness-of-fit index (GFI), Tucker-Lewis index (TLI), and root mean square residual (RMR) (Hair et al., 2019). Table 3 shows that all the indices used reached the "Good Fit" criteria.

Table 2. CR, CA, and AVE values

Variable	CR	CA	AVE
VI	0.99	0.83	0.97
IF	0.84	0.76	0.57
QT	0.94	0.84	0.63
NV	0.91	0.80	0.72
HV	0.91	0.91	0.72
ST	0.90	0.91	0.70
CI	0.83	0.90	0.55
PI	0.90	0.83	0.69
IN	0.83	0.90	0.62

According to Chang (2013), the coefficient of determination (R^2) can be classified into three categories 1) namely weak ($\text{mean} < 0.20$), 2) moderate ($0.20 < \text{mean} < 0.50$), and 3) strong ($\text{mean} > 0.50$). Table 4 shows the results of the coefficient of determination test for the research model.

4.2. Hypothesis testing

After the research model was modified and met all GoF criteria, the structural model test continued to the hypothesis testing stage. A hypothesis test was conducted to determine the relationship between the independent and dependent variables proposed in the research model. This hypothesis testing was carried out in two directions (two-tailed) with a significance level of 5%. In the test, the p (probability) value determined whether a hypothesis was accepted or rejected. The accepted hypothesis proved a significant relationship between the two variables, indicated by a p-value of less than 0.05. Conversely, if the p-value was greater than 0.05, the hypothesis was rejected, and the relationship between the two variables was considered insignificant. Table 5 shows the results of the hypothesis testing.

5. Discussion

H1: Interactivity (IN) influences hedonic value (HV)

This study found that interactivity has a significant relationship with HVs, which is consistent with C. -L. Hsu et al. (2011). C. -L. Hsu et al. (2011) also stated that the interactive experience felt by the user produces a high level of pleasure. In another study that supported this hypothesis, Nikhashemi et al. (2021) found that interactivity has a greater influence on HVs than utilitarian values. It is known that users assess interactivity in terms of the entertainment and pleasure they feel. This can also stimulate user involvement in applications that use AR.

Table 3. Goodness-of-fit values

Goodness-of-fit (GoF) criteria	Cut-off Value	Value	Description
CMIN/df	<2.0	1.995	Good Fit
RMSEA	≤ 0.08	0.045	Good Fit
NFI	≥ 0.9	0.921	Good Fit
CFI	≥ 0.9	0.958	Good Fit
GFI	≥ 0.9	0.91	Good Fit
TLI	≥ 0.9	0.95	Good Fit
RMR	≤ 0.05	0.039	Good Fit

Table 4. R² values

Variable	R ²	Description
HV	0.590	Strong
ST	0.103	Weak
CI	0.386	Moderate
PI	0.340	Moderate

H2: Vividness (VI) influences hedonic value (HV)

Based on the results of the research model analysis, H2 was rejected. These results indicate that vividness was one of the AR characteristics felt by users that did not affect the HV they felt. This contradicts the results of a study conducted by S.H. -Y. Hsu et al. (2021), which showed a positive influence of vividness on HVs. Vividness in the AR context refers to the aesthetic appeal and presentation quality of the product (Nikhashemi et al., 2021). In addition, vividness also assesses the quality of the presentation regarding clarity, sharpness, definition, and level of detail. The more realistic the product presentation is, the better the user can imagine the product they are trying (Kowalczyk et al., 2020).

However, in several studies, vividness in AR still cannot meet the appropriate definition. This was shown by Scholz and Duffy (2018), in which respondents said that the makeup appearance provided by AR felt fake and unrealistic (“Look, it’s 3D Diana! This is so fake. I’ll just try the purple eyeshadow and I’ll be like ‘oh this doesn’t look good.’ It doesn’t look realistic. Maybe it’s just too virtual.”). This also shows that the ability of AR to be more realistic in terms of the colors displayed and adjustments to product placement from the results of identification of the user’s facial features with the user’s face in the future must be improved; currently, these aspects do not offer positive feelings to users (happiness, joy, etc.) when the customer uses the feature.

H3: Novelty (NV) influences hedonic value (HV)

The AR feature’s ability to personalize the product’s appearance on the user’s body affects their pleasure when using the virtual try-on feature. Therefore, H3 was accepted. This is consistent with the research of Nikhashemi et al. (2021), which demonstrated a direct relationship between novelty variables and the hedonic benefits of users. C. -L. Hsu and Lin (2016) described novelty as a new and unfamiliar stimulus that the user feels. Meanwhile, in Smink et al. (2020), novelty is the perceived personalization value felt by the user, where the AR features used can adapt to the user’s needs and situation. Based on this understanding, S.H. -Y. Hsu et al. (2021) also explained how personalized AR feature factors can influence the user’s HV. This is due to the advantages felt by users, such as saving time searching for products and helping purchases quickly and efficiently (Choi et al., 2017). In addition, novelty itself can also be triggered by several other factors, such as the uniqueness of the feature content presented, which increases consumer pleasure in using AR features (C. -L. Hsu & Lin, 2016).

H4: System quality (QT) influences hedonic value (HV)

Based on the results of the research model analysis, H4 was rejected. These results indicate that system quality, one of the AR characteristics used as an aspect of AR in this study, does not affect the HV felt by users. The HV in this study is obtained from the user’s feelings when using the system, which is influenced by the quality of the system itself. This is inconsistent with previous research explaining system quality as a predictor of user satisfaction because it affects the user’s experience using the system (Ashfaq et al., 2020; Nikhashemi et al., 2021). According to

Table 5. Hypotheses testing results

Hypothesis				Estimate	Lower	Upper	P	Description
H1	IN	→	HV	0.136	0.017	0.259	0.021	Accepted
H2	VI	→	HV	0.144	0.031	0.318	0.098	Rejected
H3	NV	→	HV	0.604	0.487	0.749	0.002	Accepted
H4	QT	→	HV	-0.025	0.100	0.051	0.581	Rejected
H5	IF	→	HV	-0.003	-0.163	0.153	0.979	Rejected
H6	HV	→	ST	0.588	0.461	0.707	0.003	Accepted
H7	ST	→	CI	0.621	0.539	0.690	0.002	Accepted
H8	CI	→	PI	0.581	0.465	0.677	0.002	Accepted

Nikhashemi et al. (2021), the user experience when using a system is very important because it affects enjoyment (hedonic benefit).

Based on the interview results, it can be concluded that the system quality aspect of the virtual try-on feature does not affect HV because users still experience problems when using the feature. Further reviews regarding system constraints were found in research conducted by Scholz and Duffy (2018). In this study, there was also a review of the failure of the system to work optimally, thereby reducing the user's pleasure level in using AR features (“...when it scanned your face then put the fake makeup on, it wasn't exactly where my cheekbones and things are.” -User 3), (“As you move it kind of glitches a bit” -User 4). Therefore, H4 was rejected because users still experience obstacles and do not experience pleasure or feelings of happiness using these features.

H5: Product informativeness (IF) influences hedonic value (HV)

Product informativeness does not affect the HV felt by users. Therefore, H5 was rejected. The hedonic value in this study was used to determine whether users were motivated to use virtual try-on beauty and fashion products due to perceived pleasure. These findings contradict the research conducted by S.H. -Y. Hsu et al. (2021) and Vieira et al. (2022), who found that product informativeness significantly affects hedonic values. However, other research indirectly supports the relationship between product informativeness and hedonic value (Nikhashemi et al., 2021). In this study, product informativeness was categorized as AR quality. However, AR quality refers to detailed information. In this study, the relationship between AR quality and hedonic value was rejected but indirectly because the relationship between AR quality and hedonic value was moderated by AR customization. AR customization is often associated with increased enjoyment. AR customization should increase the possibility of positive effects from technology-related variables and affect a person's personality in terms of perceived ease, comfort, and enjoyment when users use AR (Nikhashemi et al., 2021). Based on the interviews in Indonesia, the primary factor contributing to product informativeness does not affect hedonic value; the information related to the products, such as shade, shape, and texture provided by virtual try-on, does not meet their expectations.

H6: Hedonic value (HV) influences satisfaction (ST)

Pleasure when using the virtual try-on feature affects user satisfaction. Therefore, H6 was accepted. These results are consistent with the research of Vieira et al. (2022), which revealed that hedonic shopping values affect consumer satisfaction. This study explains how the visual appearance of AR can affect consumer enjoyment and user satisfaction. S.H. -Y. Hsu et al. (2021) found that the hedonic value or pleasure users feel can be triggered by sensory stimulation, fantasy, and entertainment functions in AR features. In motivation theory, the hedonic value is defined as something that represents intrinsic motivation (C. -L. Hsu & Lin, 2016). Intrinsic motivation is the satisfaction and pleasure users feel from carrying out a specific behavior (C. -L. Hsu & Lin, 2016). Previous research also explained the significant effect of hedonic value, which is part of the consumer's perceived value, on user satisfaction (Babin et al., 1994).

H7: Satisfaction (ST) influences continuance intention (CI)

User satisfaction with using the virtual try-on feature significantly influences the user's continuing intention to use the feature. Therefore, H7 was accepted. This is consistent with previous research by Butt et al. (2021) and K. Kim et al. (2014), which revealed a direct positive relationship between satisfaction and CI. K. Kim et al. (2014) stated in their research that user satisfaction is a critical factor influencing sustainability intentions. This is also supported by the fact that, apart from

perceived usefulness, satisfaction is a strong predictor of user sustainability intentions. Digital content displayed by AR technology can attract user attention and influence satisfaction and intention to continue using AR technology (Butt et al., 2021).

In addition, the findings of this study are consistent with previous studies proving that satisfaction affects CI; satisfaction is a reliable factor in having a positive relationship with CI (Ashfaq et al., 2019). Akdim et al. (2022) said that when users can obtain information by interacting with technology, they will develop positive feelings, including satisfaction with the technology. Once they experience these positive feelings, it will affect their willingness to reuse the technology. Service providers using AR want to increase the sustainability intention of their users to continue using their services. Therefore, service providers need to ensure that users are satisfied with their services so that they have a positive experience (Scholz & Duffy, 2018). To achieve this satisfaction, the user's needs and desires for services must be fulfilled (Yim et al., 2017). This also applies to AR applications for beauty products designed to convince users to continue using them (Butt et al., 2021).

H8: Continuance intention (CI) influences purchase intention (PI)

Finally, H8 was accepted. This result is consistent with Scholz and Duffy (2018), who revealed a direct positive relationship between CI and PI. Kowalczyk et al. (2020) showed that the application of AR benefits service providers in providing presentations that affect customer behavioral responses. By contrast, in this study, the customer behavioral responses used return features and user purchase intentions. Moreover, K. Kim et al. (2014) found that AR smartphone applications directly affect sustainability intentions. In addition, the application of AR in e-commerce allows users to obtain more information about products and leads to increased intention to make purchases (Scholz & Duffy, 2018). No previous research has examined the relationship between CI and PI in the context of AR, especially in e-commerce. However, this study found that H8 was proven in the application of AR in e-commerce. Scholz and Duffy (2018) demonstrated a relationship between CI and PI. Purchase behavior can be seen as a deeper level of user commitment to the service platform experience.

6. Implications

6.1. Theoretical implications

This study extends the application of SOR theory to the context of AR characteristics in beauty and fashion applications and digs deeper into how pleasure, satisfaction, and intention to reuse AR affect shopping intentions. This study strengthens and expands the research conducted by Nikhashemi et al. (2021). Nikhashemi et al. (2021) proved that AR interactivity and AR novelty as part of AR characteristics significantly influence the HV of using virtual try-on to shop for retail products in e-commerce. In contrast to previous research, in this study, AR interactivity and novelty proved to be factors that influence HV but in virtual try-on for beauty and fashion products. Nikhashemi et al. (2021) found that interactivity in AR technology can facilitate user interaction activities with technology, manipulate the displays provided and engage directly with existing content. This study also strengthens the research of C. -L. Hsu et al. (2011), who consider novelty to be a part of the AR characteristic that influences hedonic values.

This study found that using virtual try-on in e-commerce in Indonesia positively affects satisfaction. Therefore, this study confirmed the findings of Vieira et al. (2022). This study found that satisfaction has a positive correlation with CI to use virtual try-on in e-commerce, consistent with Ashfaq et al. (2019), who found that satisfaction is a reliable factor and has a positive relationship with purchase attitude in which there is CI. This study also found that the reuse of virtual try-on in e-commerce influences the shopping intention of users. This was confirmed by Scholz and Duffy (2018) in a different context, namely, the effect of reusing AR in game applications with PI.

This study identified two characteristics of AR that were contrary to previous research: 1) vividness in a study conducted by Nikhashemi et al. (2021) and S.H. -Y. Hsu et al. (2021), and 2) product informativeness in research conducted by S.H. -Y. Hsu et al. (2021), showing that vividness has a positive impact on HVs. Furthermore, one other characteristic, system quality, adopted from research conducted by Butt et al. (2021), showed no relationship to hedonic values. Based on the interview results, we found that in Indonesia, the majority of virtual try-on users in e-commerce need information, display, and sound system quality to influence user pleasure, enjoyment, and happiness. Based on the findings above, the behavior of people in Indonesia differs from that observed by S.H. -Y. Hsu et al. (2021) and Butt et al. (2021) in Malaysia, Nikhashemi et al. (2021) in Taiwan, S.H. -Y. Hsu et al. (2021) in Korea, and (Butt et al., 2021) in China. These studies found that vividness, product informativeness, and system quality do not affect hedonic values.

6.2. Practical implications

In this study, the personalization aspect can be achieved by providing personalized product visualization displays where makeup and fashion products tried online can suit the user's face and body so well that the user feels they are trying the product himself. This visualization also lets users see that their appearance is unique and new when trying a product for the first time; this can help users create a pleasant feeling. In addition, e-commerce service providers and AR developers must create a more interactive online shopping experience with AR technology. The interactive experience felt by users when trying products online can improve, providing a better user experience by increasing the user's hedonic value compared to shopping online and only seeing limited products seeing product images displayed on e-commerce storefronts.

The results of this study also show that currently, the virtual try-on feature developed in Indonesian e-commerce still does not meet the good aspects of product informativeness, vividness, and system quality, so these three aspects have not been able to improve performance. Based on this, AR developers in e-commerce must evaluate existing AR features, especially these three characteristics. If so, in the future, they can be even better at developing features and ensuring that users feel happy by identifying deficiencies and limitations in current AR features and improving them to meet the needs and expectations. E-commerce service providers must understand the various information users need about products and how AR developers can package the information needed by these users through product visualizations displayed in the virtual try-on feature.

In addition, AR developers must ensure that all information provided through visualization is realistic. This has implications for developers to continue innovating AR technology that can add digital content (visualized products) to realistic user reality. Furthermore, this development must also be accompanied by system quality to reduce the technical problems experienced by users when using features. These include product visualizations that don't appear, the level of responsiveness of the system in providing visualizations and changing according to the user's wishes, and how the system can identify facial and body features users correctly and precisely so that product visualizations are placed correctly.

7. Conclusions

This study accepted five out of eight hypotheses. Interactivity and novelty affect hedonic values; vividness, product informativeness, and system quality do not affect hedonic values. Accordingly, this study also demonstrated the significant influence of hedonic values on satisfaction. Satisfaction had a significant effect on CI, and CI had a significant effect on PI. Suggestions for the future are that e-commerce service providers and AR developers apply AR to other products, not just beauty products and glasses. The limitation of this research is 49.7% of respondents lived in Greater Jakarta. The value of the coefficient of determination (R^2) of the CI and PI variables produced only a moderate effect. This shows that other factors can explain the intention to continue using AR features and the user's shopping intention in e-commerce applications. Future research could examine other variables that can better explain CI and PI, such as media usefulness, brand engagement, and psychological inspiration.

Funding

The work was supported by the Universitas Indonesia for the Grant Hibah Publikasi Terindeks Internasional/PUTI Q2 Number NKB-570/UN2.RST/HKP.05.00/2023

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Disclosure statement

No potential conflict of interest was reported by the authors.

Citation information

Cite this article as: The influence of augmented reality on E-commerce: A case study on fashion and beauty products, Adelya Gabriel, Alina Dhifan Ajriya, Cut Zahra Nabila Fahmi & Putu Wuri Handayani, *Cogent Business & Management* (2023), 10: 2208716.

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Appendix A Questionnaire Instruments

Code	Measurement Items	References
IN1	I have full control of the AR feature's navigation menu.	McLean and Wilson (2019), Kowalczyk et al. (2020)
IN2	I have complete control over the products and variations available through the AR feature.	
IN3	I have full control over the duration to see the product through the AR feature.	
IN4	I can interact with virtual product displays through AR features to get product-related information that fits my specific needs.	
VI1	I feel the visual appearance of the product on the AR feature is clear.	McLean and Wilson (2019)
VI2	I feel that the visual appearance of the AR feature is detailed.	
VI3	I feel that the visual appearance of the product on the AR feature looks realistic.	
VI4	I feel that the visual appearance of the product on the AR feature looks clear.	
IF1	I get detailed product information by using the AR feature of an e-commerce application.	Kowalczyk et al. (2020)
IF2	I get complete product information by using the AR feature in an e-commerce application.	
IF3	I can make shopping decisions from the information I get when using AR features in e-commerce applications.	
IF4	I can compare product information with other products when using the AR feature in e-commerce applications.	
QT1	I feel that the AR feature in e-commerce applications displays product visualizations quickly.	Kowalczyk et al. (2020)
QT2	I feel that the AR feature in e-commerce applications can be relied upon to carry out its functions properly without any problems/errors on the system.	
QT3	I feel that the AR features in e-commerce are working for my purposes.	
QT4	I assume that there are no problems using AR features in e-commerce applications.	

(Continued)

Code	Measurement Items	References
NV1	I feel that the AR feature gives a new look to the user the first time they try the product.	McLean and Wilson (2019)
NV2	I feel that the AR feature gives a unique look to each product.	
NV3	I feel that the AR feature makes a difference for each product.	
NV4	I feel that the AR features show something unusual for each product.	
HV1	I feel that e-commerce applications equipped with AR features are more fun.	Nikhashemi et al. (2021)
HV2	I feel the time I spent using the virtual try-on feature was a good thing.	
HV3	The virtual try-on feature entertains me by seeing a new view of myself when trying products virtually.	
HV4	I feel happy when I use the virtual try-on feature.	
ST1	I feel satisfied because my need to try products is fulfilled by using AR features in e-commerce.	Butt et al. (2021), McLean and Wilson (2019)
ST2	I am satisfied with the suitability of product visualization when using AR features in e-commerce.	
ST3	The experience of using the AR feature is in line with my expectations.	
ST4	Overall, I feel satisfied in using the AR feature in e-commerce to try a product.	
CI1	I intend to continue using the AR features of this app.	Nikhashemi et al., (2021)
CI2	I will be using the AR feature of this app a lot in the future.	
CI3	I would recommend the app's AR features to others.	
CI4	I will be using the AR features of this app regularly in the future.	

(Continued)

(Continued)		
Code	Measurement Items	References
PI1	I will buy a product that I have previously tried through the virtual try-on feature available on e-commerce soon. (e.g., already added the product to your cart and will pay for it soon).	Arghashi (2022), Qin et al. (2021)
PI2	I want to buy a product that I have previously tried through the virtual try-on feature available on e-commerce soon (e.g., there is a desire to buy a product but have not taken any action).	
PI3	I hope to buy a product that I have previously tried through the virtual try-on feature available on e-commerce soon. (Example: Adding the product to my wish list).	
PI4	I will recommend the product that I tried through the virtual try-on feature.	

Appendix B Interview Instruments

- (1) Have you ever used the virtual try-on feature before the COVID-19 pandemic?
- (2) Has your intensity of using virtual try-on increased after the COVID-19 pandemic?
- (3) What information do you want to get when using a virtual try-on?
- (4) Does the virtual try-on feature you use meet your expectations/desires?
- (5) Does this affect your enjoyment when shopping and trying products using a virtual try-on?
- (6) In your opinion, what needs to be improved so that the information you want can be achieved?
- (7) What problems did you experience when using the virtual try-on feature?
- (8) How do these obstacles affect your feelings when using a virtual try-on? (Example: upset, disappointed, etc.)
- (9) What aspects do you think can help improve the quality of the virtual try-on system?
- (10) What do you expect when you see the look of the product on your face when using a virtual try-on?
- (11) In your opinion, how does the product display when using a virtual try-on?
- (12) How does this display affect how you feel when using a virtual try-on? (Example: happy, satisfied, etc.)