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Integrating technology acceptance model and value-based adoption model to determine consumers' perception of value and intention to adopt AR in online shopping

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Abstract

Purpose – This study is among the first to integrate the technology acceptance model (TAM) and value-based adoption model (VAM) in the context of augmented reality (AR) shopping. It assesses how consumers' rational (TAM) and emotional (VAM) factors influence their intention to use AR in online shopping via perceived value and consumer engagement.

Design/methodology/approach – This study uses a quantitative research approach and employs a standardized survey questionnaire distributed on social media platforms to recruit Gen Z members who are potential buyers or users of AR technology. SmartPLS 4.0 was used to test the responses of 204 respondents.

Findings – The results indicate that consumers who perceive a higher value of AR in shopping are inclined to use AR in their future shopping when AR shopping is easy to use, useful, personalized, innovative and provides a highly engaging experience. Interestingly, perceived sacrifice did not influence perceived value. This study confirms that integrating TAM and VAM is instrumental in capturing value, which in turn influences engagement and the intention to use AR in online shopping.

Originality/value – This study further extends the conceptualization of AR perceived value by combining rational components derived from TAM and VAM, thus leading to a sturdy and theoretically grounded framework. In addition, this study contributes to the literature on extended reality, namely AR shopping, and helps brand managers manage highly evolving AR experience for Gen Z.

Keywords Generation Z, Extended reality, Augmented reality, Technology acceptance model, Value-based adoption model

Paper type Research paper

1. Introduction

The adoption of augmented reality (AR) technology has revolutionized how businesses engage with their customers, unlocking new levels of personalization and engagement in the shopping experience (Romano *et al.*, 2021). For instance, with the help of an AR app on their

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smartphones, consumers can point to their phones on a restaurant menu and see 3D images of the dishes, helping them make informed choices. As AR applications and games, such as Pokémon Go and IKEA Kreativ, continue to gain popularity, AR is poised for further growth. Growth is also driven by advances, such as 5G networks, which offer faster data rates and lower latency, making it easier for cloud-based AR technology to be delivered and experienced (Joshi and Jain, 2022). Not surprisingly, the AR market is expected to reach USD 174.47 billion by 2028, with a compound annual growth rate (CAGR) of 42.36% (Mordor Intelligence, 2023). Thus, it has led many leading companies in the retail sector (e.g. Nike, Apple and L'Oreal) to develop AR apps for customers to reap the benefits of AR (Marr, 2021).

The implementation of AR itself does not provide an ultimate marketing solution. Scholars suggest that AR should be well incorporated with other marketing components, such as customer relationship management (Rauschnabel *et al.*, 2022). For example, in the field of tourism management, AR tours are offered by destination marketing organizations which allow tourists to engage with interest points in an interactive manner (Rauschnabel *et al.*, 2022). It is also believed that AR marketing has the potential to simplify tourism service encounters by offering improved visualization and personalization of experiences (Buhalis *et al.*, 2019). Companies benefit from the heightening of AR as it has been indicated that the adoption of AR in their marketing strategies has a high potential to boost online conversion rates, enhance customer satisfaction and leverage their brand reputation (Smink *et al.*, 2019). AR technology enhances the consumer experience and has led to new value assessments of products and services. This has resulted in increased adoption of AR in online shopping, especially among Gen Z shoppers (Pasquali, 2022).

The existing research on the impact of AR tools on consumer behavior primarily focuses on the adoption of the technology using the Technology Acceptance Model (TAM) (Khan *et al.*, 2024), UTAUT2 model (Khashan *et al.*, 2023) and Stimulus Organism Response (SOR) (Lee *et al.*, 2022). Existing studies on AR tools emphasize technology acceptance and its impact on adoption and purchase intention (Khashan *et al.*, 2023; Lim *et al.*, 2024). For instance, Serravalle *et al.* (2023) examined how consumer involvement with their products can impact the AR flow experience, leading to a behavioral intention to purchase the product or visit retail stores. However, research on how AR drives consumer intention through value creation and engagement using theoretical models with empirical evidence is limited.

Voicu *et al.* (2023) highlighted that value is important for consumers' consequent intentions towards AR in shopping. The value-based adoption model (VAM) proposes that personalization and perceived sacrifice are antecedents of perceived value (Srivastava *et al.*, 2023). However, previous studies that investigated value in the context of AR did not include these antecedents to determine its influence on value leading to intention (Xue *et al.*, 2023; Voicu *et al.*, 2023; Erdmann *et al.*, 2023). Additionally, TAM has been established to influence consumers' intention to use AR (Jiang *et al.*, 2022). As AR is a rapidly evolving technology and the significance of value cannot be overstated (Voicu *et al.*, 2023), we propose that VAM be incorporated to better capture the interrelationships between value and intention, which is instrumental in the acceptance of recent technologies, especially among Gen Z, which constitutes the growing number of users in AR shopping.

Based on the preceding discussion, the current study proposes the integration of TAM and VAM as the theoretical framework to address the gaps, namely, in understanding the antecedents to value that drive engagement and adoption of AR in online shopping from a theoretical model standpoint. The need for the current study is further substantiated by the undeniable growth of AR in online shopping and its implications for consumers' experiences of extended reality. This study introduces additional factors for marketers to focus on to increase consumers' AR use in shopping. It also provides insights into the potential benefits and trade-offs that consumers may encounter in embracing AR shopping. More specifically,

it discusses how the VAM complements and enhances the TAM in capturing and explaining consumers' intention to use AR in shopping.

2. Theoretical background

2.1 The technology of acceptance model

The Technology Acceptance Model (TAM) offers a valuable overarching structure, aligning with findings from various studies on the factors affecting consumers' willingness to adopt new technologies (Davis, 1989). It provides a comprehensive framework that includes perceived ease of use, perceived usefulness, attitudes towards technology and behavioral intention (Davis *et al.*, 1992). According to the tenets of TAM, customers' opinions on the utility and usability of new software or technology influence their decisions regarding when and how to use it.

In the current study, two determining factors of intention to use TAM: perceived usefulness and perceived ease of use are applied. The adoption of TAM with these two factors is similar to past studies that have investigated the use of technology in predicting consumer behavior with other theories (Ganjipour and Edrisi, 2023; Mustafa *et al.*, 2021). However, evidence emerges that perceived usefulness and perceived ease of use do not directly influence the intention to use technology. Several intervening variables can enhance the influential effect, such as satisfaction (Lee *et al.*, 2023), age and gender (Abdullahi and Mahmud, 2023), system quality and perceived playfulness (Jiang *et al.*, 2022). TAM has been extended by numerous researchers, including Xing *et al.* (2024) and Leong and Koay (2023), to include a comprehensive predictive model. As a result, the current study aims to investigate the relationship between perceived usefulness and ease of use on perceived value.

2.2 Value-based adoption model

When examining the intention to use, VAM identifies benefits, encompassing usefulness, enjoyment and sacrifices, including minor details and anticipated costs, as the primary perceived value factors (Kim *et al.*, 2007). VAM considers the monetary sacrifice element by comparing costs and benefits, emphasizing perceived sacrifice and personalization as benefits. By assessing costs and uncertainties, the additional benefit pattern correctly captures how decisions are made when considering the widespread use of an innovative technology or item (Lin *et al.*, 2012).

Kim *et al.* (2007) developed VAM to enhance TAM in describing the widespread use of novel technologies for information and communication, such as AR shopping. As a result, VAM and TAM are concurrently examined in past studies to determine the adoption of extended reality such as virtual reality applications (Rafdinal *et al.*, 2024) and fitness wearables (Mathavan *et al.*, 2024). The inclusion of VAM in the current study is to capture the value perceived through the benefits and trade-offs inherent in the usage of technology in a new context, which is AR in shopping. The VAM considers value maximization and offers a straightforward and effective approach for predicting AR shopping adoption.

Benefits and trade-offs can be examined from a multitude of perspectives. Previous studies on AR in shopping have included product integration (Barta *et al.*, 2023), functional value (Xue *et al.*, 2023) and confidence (Sun *et al.*, 2022) as benefits of consumers' behavioral responses. However, trade-offs have been investigated through information overload (Zheng and Li, 2023), interactivity speed and quality (Baytar *et al.*, 2020) and productive design risk (Hoffmann *et al.*, 2022). It is evident from these past studies that personalization is vital for the experience of AR (Akdim and Casaló, 2023). The impact of using AR on personal innovativeness has not been investigated before in the context of AR in shopping.

3. Hypothesis development

Perceived ease of use refers to how easily consumers feel they could use an application without much effort (Van der Heijden *et al.*, 2003). Gen Z consumers hold certain expectations regarding emerging technologies, which substantially impacts their overall experience. For instance, they expect new technologies and automated processes to become widely available. They envision these advancements will provide them with increased autonomy and quicker transactions (Ameen *et al.*, 2023). This underscores that consumers' perceptions of value when using new AR technologies for buying may be strongly influenced by their degree of knowledge. Additionally, past studies indicate that consumers' intention to use such technologies is positively correlated with perceived usefulness and ease of use of the technology (Park and Kim, 2023; Trinh *et al.*, 2020). Thus, the following is postulated:

H1. Perceived ease of use has a positive impact on perceived value.

Customers' engagement with AR applications is significantly influenced by the AR elements presented and characteristics related to technology adoption, such as perceived usefulness (Arghashi and Yuksel, 2022). The concept of perceived usefulness pertains to consumers' perception of the alignment of the value proposition inherent in the use of products to their individual lifestyle needs and preferences (De Kervenoael *et al.*, 2021). This process involves comprehensive evaluation of the benefits and drawbacks of a product. Holdack *et al.* (2022) found that individuals who perceive AR as a valuable tool for their buying choices are more likely to view AR technology as more beneficial, resulting in a positive attitude towards it. Based on this discussion, the perceived usefulness of AR is considered an important condition that affects how customers view the advantages and disadvantages of technology and, in turn, influences how they perceive value (Schultz and Kumar, 2024). Thus, the following is proposed:

H2. Perceived usefulness has a positive impact on perceived value.

Personalization technology utilizes real-time customer information to provide relevant content that enhances the customer experience and aligns with a company's goals (Blümel *et al.*, 2024). A study found that Gen Z individuals prefer personalized technology and are optimistic about the potential advantages of GenAI, such as improved productivity, efficiency and personalized experiences (Chan and Lee, 2023). Gen Z's ability to personalize a product increases the likelihood of making a purchase and personalization is expected to become even more prevalent, as consumers of all age groups anticipate that future websites will seamlessly communicate with each other and deliver more tailored results (McKee *et al.*, 2023).

Personalization is the strongest determinant of perceived value, as Akdim and Casaló (2023) indicated in their study of voice assistance through personalized recommendations. According to Alimamy and Gnoth (2022), personalization could reduce the risk perceived by consumers as it eases the tough decision-making process via a targeted configuration of consumer information and product attributes. The use of AR applications to personalize online shopping would create a highly engaged and relevant experience that leads consumers to feel valued and understood. Consequently, consumers perceive value through personalization of the AR. Thus, we postulate that:

H3. Personalization has a significantly positive influence on perceived value.

Consumers believe that a higher price indicates a greater value of goods and that purchasing goods would require a larger financial commitment. The perceived value arises from the trade-off between perceived advantages and sacrifices (Lee and Chen-Yu, 2018). Perceived sacrifice is anything given up in exchange for a good or service (Zeithaml, 1988), which

include both monetary and non-monetary elements, such as time, expenses and physical exertion (Lucas *et al.*, 2023).

In addition, the sacrifice element is also evident when Gen Z is prepared to trade up their data and privacy for the customization that contemporary technology can provide (Dinham, 2019). Despite being recognized as a generation hesitant to make financial sacrifices, Gen Z individuals are strongly concerned about social issues and may perceive a product or service as having social costs that warrant financial sacrifices (Dabija and Bejan, 2018). Building upon Yoon and Oh's (2022) findings, if consumers perceive the sacrifice of using AR technology to be greater than the benefit, they will perceive the technology to have a low value. Thus, sacrifices such as money and time have negative connotations in Gen Z's perception of the use of AR in shopping. Hence, we propose that:

H4. Perceived sacrifice has a significantly negative influence on perceived value.

Perceived value is defined as consumers' perception of a product's utility based on what they were given and received through their overall assessment (Zeithaml, 1988). Given the costs they must bear to achieve the greatest utility or satisfaction, consumers will strive to maximize their benefits. Moreover, consumers who perceive emotional and functional values tend to engage with retailers because of their established connection with brands, which leads to active engagement and interaction (Rodriguez and Sangle-Ferrier, 2023).

On the other hand, Jia *et al.* (2023) suggested that consumers' success in achieving utility encourages continuance intention to watch streams and influences their ways of performing a specific action. Similarly, Kim and Kyung (2023) suggest that perceived benefits could affect adoption intention as individuals place excessive importance on technology usefulness in their daily lives. Therefore, this study hypothesizes the following:

H5. Perceived value has a significantly positive influence on customer engagement.

H6. Perceived value has a significant positive influence on intention to use.

As described by Rašković *et al.* (2016), consumer innovativeness pertains to the inclination to purchase new products rather than adhering to established consumption patterns. Domain-specific innovativeness (DSI), which reflects the inclination to purchase specific categories of new products, is positively and significantly linked to innovation adoption (Araujo *et al.*, 2016). Pillai *et al.* (2024) found that when consumers perceive innovation positively, their inclination to shop for fashion apparel in Metaverse increases. This inclination suggests that innovative products or services are perceived as different from competitors, potentially enhancing their perceived value.

Given that AR technology is seen as new, Gen Z may value innovation and technology since they were raised in the digital age and associated innovation with enhanced perceived deservingness (Ameen *et al.*, 2023). Owing to their unique characteristics, higher performance, different experiences and imaginative brand image, innovative goods or services may be viewed as having more value (Coelho *et al.*, 2020). Hence, we propose that:

H7. Perceived innovativeness has a significantly positive influence on perceived value.

Engagement has received considerable attention over the past decade. Scholars have explored the concepts of multifaceted approaches, such as cognitive and emotional dimensions, to explain their underlying meaning (Cheung *et al.*, 2015). Previous research has revealed that consumers who experience a profound engagement with an object demonstrate a strong inclination to sustain their relationship with it (Ng *et al.*, 2020). Consequently, consumers tend to assess how much time is required to interact with an object. A study in the context of Open Online Courses revealed that highly engaged students on online learning platforms tended to persist in their learning platform usage (Sun *et al.*, 2020). Therefore,

customer engagement has been identified as a catalyst for enhancing consumers' intentions to use AR tools. Thus, the following is hypothesized:

H8. Customer engagement influences the intention to use.

The complete research model is presented in Figure 1.

4. Methodology

4.1 Sampling procedure

This study used a quantitative method to gather numerical information to examine the connection between independent and dependent variables. This strategy was chosen because it offers a wide variety of statistical support and allows for dispassionate analysis of the gathered data. The convenience sampling method was adopted for its practicality in efficiently accessing respondents within a specific demographic, namely Generation Z. The survey was distributed to individuals belonging to Generation Z through social media platforms such as Twitter, Facebook and Instagram, targeting specific groups and communities. The respondents were approached through groups and communities on social media. Respondents are encouraged to circulate the survey within their networks to expand participation. To be eligible for the survey, they must be Generation Z born between the years 1999–2006. According to Ameen *et al.* (2023), this generation is known for its familiarity with a wide array of technologies, including omni-channels, virtual reality and metaverse technologies, which makes them ideal participants for this study.

The survey was conducted using Google Forms and respondents were required to answer all the questions. Initially, 247 responses were collected, but due to incomplete data and abandoned submissions, the final dataset recorded 204 responses. The sample size of 204 is adequate for robust statistical analysis, consistent with previous studies, such as those conducted by Edgar and Manz (2017). Moreover, the sample data meets the minimum threshold suggested by Green (1991), using the formula of 50+8k., where k is the number of constructs. Since there are seven constructs in the conceptual framework, a total of 106 responses are required [50 + 8(7) = 106]. The surplus of responses serves as supplementary data for enhanced stability. The data were analyzed to explore the respondents' background and structural equational modeling with partial least squares (SEM-PLS).

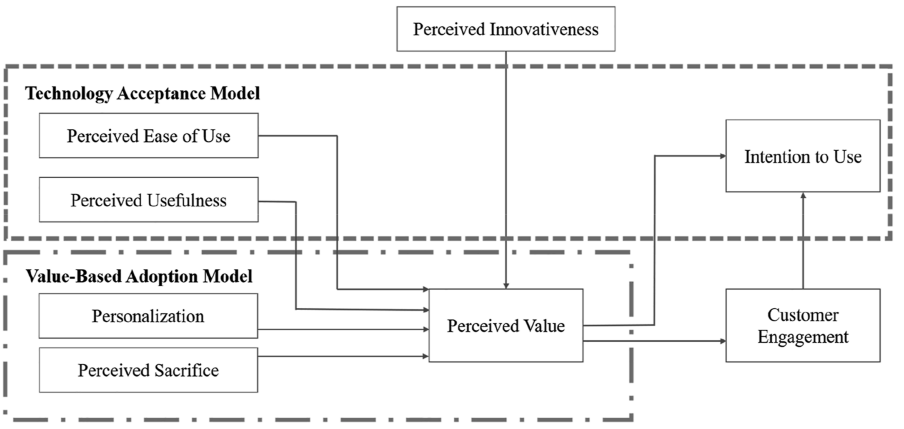

Figure 1.
Research model

Source(s): Adapted from Davis *et al.* (1992) and Kim *et al.* (2007)

Within the participant pool, the majority were male (68%) and 32% were female. Regarding ethnicity, 78% were identified as Chinese, 9% as Malay, 12% as Indian and 1% as other. These demographics were selected based on the target population of Generation Z, aged between 18–25 years old.

4.2 Measures

We used established and verified measurement scales from prior research on the study variables. Perceived ease of use and usefulness were adapted from Davis (1985, 1989), personalization was adapted from Ball *et al.* (2006) and perceived value was adapted from Cronin *et al.* (2000) and Zeithaml (1988). Perceived sacrifice, innovation, customer engagement and intention to use were adapted from Ameen *et al.* (2021), Hwang *et al.* (2019), Vinerean and Opreana (2021), Ajzen (1991) and Han and Hyun (2017), respectively.

The measurement scales underwent minor adaptations to suit the specific context of this study and are available in Appendix. Participants were asked to express their agreement with statements concerning their intentions and motivations for using AR tools on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

5. Data analysis

5.1 Measurement model

Reliability, convergent validity and discriminant validity were tested to ensure the quality of measurement models. Table 1 shows that all Cronbach's alphas and composite reliabilities were above the threshold values of 0.7 by Jöreskog (1971). Meanwhile, the average variance extracted (AVE) and outer loading values were above the cut-off values of 0.5 and 0.7, respectively (Hair *et al.*, 2019), reflecting convergent validity. PS1, PS3, PS5, PS7, CEE3 and CEE4 were removed because the outer loading did not exceed the minimum loading of 0.4.

The decision to remove the specific items from the scales was made through rigorous analysis and consideration, including the item performance metric of factor loadings. In support of our decision, we have drawn upon existing literature that removed 28 items out of 60 items by Hadie *et al.* (2019). The precedent illustrates that removing items can be necessary to enhance redundancy, reliability and validity of constructs, although it involves removing items that do not contribute to the measurement of constructs. This approach is consistent with the principles of scale purification to strengthen psychometrics properties.

A similar consideration applies to customer engagement. Since customer engagement is a multidimensional construct comprising 11 items, two items were removed. This constitutes less than 50% of the total items. The items were removed due to their low factor loadings. Removing these items enhanced the scale's internal consistency without compromising the construct's comprehensive assessment.

The heterotrait-monotrait ratio (HTMT) criteria were used to test discriminant validity. As shown in Table 2, all values were far below the cut-off threshold of 0.9. This indicated that the data had no issues with discriminant validity.

5.2 Structural model

Structural equation modeling was assessed by testing the proposed relationships with a pre-detection of multicollinearity issues using SmartPLS4.0. Upon analysis, there were no multicollinearity issues, as none of the VIF values exceeded 5. Subsequently, a bootstrapping procedure involving 5,000 re-samples was employed to assess the significance of the path coefficient, as recommended by Hair *et al.* (2019). The comprehensive structural equation modeling is presented in Table 3. The results showed that perceived ease of use ($\beta = 0.272$, $p < 0.000$), perceived usefulness ($\beta = 0.221$, $p < 0.05$), personalization ($\beta = 0.273$, $p < 0.00$) and

Construct	Item	Loading	Cronbach's alpha	Composite reliability	Average variance extracted (AVE)
Perceived ease of use	PEO1	0.889	0.878	0.924	0.803
	PEO2	0.850			
	PEO3	0.873			
Perceived usefulness	PU1	0.872	0.789	0.876	0.703
	PU2	0.784			
	PU3	0.813			
Personalization	PER1	0.801	0.798	0.881	0.712
	PER2	0.841			
	PER3	0.881			
Perceived sacrifice	PS1	Removed	0.717	0.838	0.633
	PS2	0.776			
	PS3	Removed			
	PS4	0.789			
	PS5	Removed			
	PS6	0.826			
	PS7	Removed			
Perceived value	PV1	0.723	0.786	0.875	0.701
	PV2	0.798			
	PV3	0.901			
Perceived innovativeness	PI1	0.888	0.887	0.928	0.812
	PI2	0.944			
	PI3	0.848			
Intention to use	INT1	0.897	0.897	0.935	0.827
	INT2	0.885			
	INT3	0.831			
Customer engagement			0.886	0.907	0.524
(Emotional)	CEE1	0.957			
	CEE2	0.871			
	CEE3	Removed			
	CEE4	Removed			
(Behavioral)	CEB1	0.857			
	CEB2	0.807			
	CEB3	0.939			
(Cognitive)	CEC1	0.880			
	CEC2	0.888			
	CEC3	0.833			
	CEC4	0.833			

Table 1.
Measurement model

Source(s): Authors' own creation

Construct	1	2	3	4	5	6	7	8
1. Consumer engagement								
2. Intention to use	0.488							
3. Perceived ease of use	0.292	0.402						
4. Perceived innovativeness	0.184	0.144	0.133					
5. Perceived sacrifice	0.607	0.483	0.312	0.234				
6. Perceived usefulness	0.251	0.448	0.615	0.122	0.553			
7. Perceived value	0.428	0.548	0.623	0.273	0.369	0.653		
8. Personalization	0.354	0.470	0.504	0.183	0.406	0.652	0.655	

Table 2.
Heterotrait-monotrait ratio (HTMT)

Source(s): Authors' own creation

Relationship	Path coefficient	Standard error	t value	95% BCCI	p value	Decision	f^2
Technology acceptance model							
H1: Perceived ease of use → Perceived value	0.272	0.073	3.743	[0.129, 0.413]	0.000	Supported	0.092
H2: Perceived usefulness → Perceived value	0.221	0.087	2.531	[0.043, 0.385]	0.011	Supported	0.049
Value-based adoption model							
H3: Personalization → Perceived value	0.273	0.078	3.480	[0.114, 0.425]	0.000	Supported	0.092
H4: Perceived sacrifice → Perceived value	0.016	0.059	0.264	[−0.094, 0.142]	0.792	Not supported	0.000
H5: Perceived innovativeness → Perceived value	0.140	0.055	2.529	[0.035, 0.251]	0.011	Supported	0.033
H6: Perceived value → Customer engagement	0.393	0.066	5.924	[0.258, 0.514]	0.000	Supported	0.182
H7: Perceived value → Intention to use	0.347	0.071	4.884	[0.198, 0.478]	0.000	Supported	0.146
H8: Customer engagement → Intention to use	0.311	0.067	4.651	[0.182, 0.441]	0.000	Supported	0.117

Source(s): Author's own creation

Table 3. Structural model

perceived innovativeness ($\beta = 0.140$, $p < 0.05$), but not perceived sacrifice ($\beta = 0.016$, $p > 0.05$), had a significant positive influence on perceived value. Therefore, H1, H2, H3 and H5 were supported, but H4 was not. Furthermore, perceived value significantly influenced customer engagement ($\beta = 0.393, p < 0.001$) and intention to use ($\beta = 0.347, p < 0.001$). It was also shown that customer engagement influenced intention to use ($\beta = 0.311$, $p < 0.001$). Thus, H6, H7 and H8 were supported. The effect sizes of path coefficients (f^2) are listed in Table 3.

The explanatory powers of perceived values and behavioral intention were 0.439 and 0.302, respectively. According to Hair *et al.* (2011), R^2 values of 0.75, 0.5 and 0.25 can be interpreted as significant, moderate and limited explanatory power, respectively. The out-sample explanatory power was assessed using PLSpredict (Shmueli *et al.*, 2019) and is displayed in Table 4. In PLSpredict, Q^2 values compared the prediction errors of the PLS-path model with the basic mean predictions. Any Q^2 value that exceeded zero signified the predictive relevance of the PLS-path model. These findings indicate that the Q^2 value is 0.189, which is greater than zero. This signified that the predictive relevance of the partial least squares path model was established. Some of the RMSE and MAE values were smaller than those of the linear regression model, which showed moderate predictive power.

		PLS		LM		PLS-LM	
Item	Q^2predict	RMSE	MAE	RMSE	MAE	RMSE	MAE
INT1	0.155	0.769	0.612	0.749	0.611	0.020	0.001
INT2	0.173	0.773	0.645	0.781	0.625	−0.008	0.020
INT3	0.136	0.810	0.690	0.829	0.708	−0.019	−0.018

Source(s): Authors' own creation

Table 4. PLS-predict

6. General discussion

Following the theoretical foundation of the TAM, the results show that perceived ease of use and usefulness strongly influence perceived value. When Generation Z consumers perceive AR as easy to use and useful, they tend to see it as more valuable and develop a positive intention to embrace it. This significant relationship between perceived ease of use and perceived usefulness with value shows that the use of AR in shopping, which has intuitive interfaces with hassle-free features that make it easy to use, is deemed valuable by consumers.

Our study found that personalization positively impacts perceived value, ease of use and usefulness. These findings align with Akdim and Casaló (2023), who discovered that personalization features, such as recommendations based on past purchases, would encourage customers to make informed decisions that eventually increase their perceived value. Our study further indicates that personalization AR experiences, such as delivering customized content by analyzing users' preferences and shopping history, presenting interactive product showcases for real-world visualization and employing geospatial personalization for tailored information through location-based data would lead consumers to perceive value in the use of AR in shopping.

However, the findings failed to show a significant relationship between perceived sacrifice and perceived value. These findings contrast with a previous study by Zhong and Chen (2023), which showed a significant negative relationship. Their study indicated that consumers express awareness and concern about perceived sacrifices, particularly for WeChat and Alipay applications, which store financial data such as expenditure settlement and income in the social software, potentially diminishing their perception of value. Thus, the probable cause for the insignificant relationship between perceived sacrifice and value in the current study might be attributed to the novelty of AR technology. Consumers, especially Generation Z, are keen to explore AR tools, and thus, perceived sacrifice does not influence its usage. Hence, perceived sacrifice in using AR for shopping appears irrelevant to the value gained.

The findings also showed that perceived innovativeness significantly influences perceived value. This is consistent with Yen's (2023) findings, where perceived personal innovativeness significantly impacts usage intention in the food delivery sector. Consumers with high personal innovativeness trait tend to perceive lower risks about adopting technology, as they hold stronger beliefs about it. Interestingly, Wang and Chiu (2023) discovered that service innovativeness does not impact the relationship between service encounters and the perceived value of fitness services. The inconsistent findings between the current and previous studies may be attributed to the conceptualization of innovativeness either at personal or service level and the examination of its direct, indirect and moderating roles concerning the outcome variable of value and the different contexts of the studies. Therefore, the role of innovativeness in relation to value requires further study to better understand its interrelationships.

This study also found that perceived value significantly influences consumer engagement, subsequently influencing the intention to use AR tools. Similarly, Rodriguez and Sangle-Ferrier (2023) discovered that consumers who perceive positive emotional values towards technological tools are keen to invest time and effort in engaging with them. Furthermore, consumers who recognize the advantages of AR tools are more inclined to continue using them (Kim and Kyung, 2023). This study confirms the positive effect of value on consumers' engagement and intention to use AR, thus supporting the importance of value derived from using AR in online shopping.

This study also revealed that consumers who feel engaged with an object are more likely to develop a higher intention to use AR tools. This finding aligns with Milanesi *et al.* (2022), who proposed that gamified experience could boost emotional and social brand engagement,

consequently increasing sales through entertaining experiences facilitated by gamified application technology for luxury companies. This study serves as a preliminary examination of consumer engagement in AR development to determine whether consumers' intentions to use the technology in their future purchase behavior depend on engagement.

6.1 Theoretical contributions

This study provides a more comprehensive picture of how TAM, focusing on perceived ease of use and usefulness, in addition to VAM, considering personalization and perceived sacrifice, influences value, engagement and consumer's intention to use AR in shopping. Perceived innovativeness was also included in determining its influence on engagement and the intention to use AR in online shopping. While many researchers have employed the TAM to assess AR technology, Kim *et al.* (2017) suggested incorporating the VAM to comprehensively evaluate consumer acceptance of technology, such as AR. Importantly, this study is the first to investigate the perceived value of AR in shopping through rational factors (TAM) and emotional factors (VAM), thus leading to a robust and theoretically grounded framework.

Our study provides evidence that TAM, through perceived ease of use and usefulness influences the value of AR, which also determines engagement and consumers' intention to use it for shopping. From the perspective of VAM, benefits through personalization also influence engagement and intention, whereas sacrifices do not. Additionally, personal innovativeness influences perceived value, which in turn influences engagement and intention. The current study also empirically verifies the significant link between consumer engagement and intention to use AR tools. Thus, an integrated model consisting of TAM and VAM is proposed to measure adoption intention including other vital variables necessary for new technology adoption, which are innovativeness and engagement. Our study lends further theoretical credence to the inclusion of VAM, as evidenced by the proliferation of recent studies (Mathavan *et al.*, 2024; Sharma *et al.*, 2024). However, the theoretical framework combining TAM and VAM requires further validation in differing contexts and samples due to the findings of the current study where sacrifice did not affect perceived value in the context of the use of AR technology in shopping.

6.2 Managerial implications

Given the study's findings demonstrating a positive relationship between perceived ease of use and perceived value, it is imperative for managers to engage with consumers by highlighting the user-friendly features of AR technology and its added value. Activities such as content marketing via owned media can create awareness and educate consumers on the features for ease of use and benefits of AR in shopping to add value to the consumers' experience with the company. Marketers can also apply paid media, such as influencer marketing, to highlight AR shopping tools and showcase their utility, as perceived usefulness contributes to an enhanced perceived value for consumers. Businesses should strive to innovate AR tools by introducing new features, functions, or capabilities that align better with consumer needs or desires, setting a product or service apart from competitors and cultivating a sense of exclusivity. This study indicates that when consumers perceive higher value, they tend to be more engaged and consequently have higher intentions to adopt AR in shopping. Hence, companies can leverage consumers' high personal innovativeness trait to encourage early adoption. Furthermore, consumers' high personal innovativeness might motivate them to share their experience via user-generated content across diverse platforms to drive the growth of AR usage in shopping.

Finally, enabling the personalization of the AR tool is imperative as it fosters deeper engagement between customers and the brand through value derived. Personalization can be

achieved when companies allow consumers to tailor the AR experience according to their individual needs and desires. For instance, incorporating features that allow consumers to visualize the AR shopping experience with their own appearance or leveraging past browsing and purchase data to offer tailored product recommendations to consumers. This fosters a personalized AR experience, facilitating engagement between the service provider and consumers, thereby nurturing consumer-brand relationships.

7. Conclusion

7.1 Limitations and future recommendations

Since the current study utilized cross-sectional data, it is advisable to conduct longitudinal research to track consumer attitudes, behaviors and intentions over an extended period. Longitudinal studies can reveal evolving trends, potential barriers and shifts in consumers' perspectives and adoption rates concerning AR shopping. Ongoing monitoring will provide valuable insights into the long-term viability and acceptance of AR shopping.

As this study examined only AR for online shopping, future researchers should conduct comparative studies to assess the effectiveness of AR shopping with other emerging extended reality technologies or retail approaches, such as virtual reality (VR) and smartphone applications. Such comparisons would aid in comprehending the benefits and restrictions of AR purchasing compared with other technologies and allow the examination of the validity of the integrated model of TAM and VAM in other new technology adoption.

The third limitation of current research is its limited consideration of other potential variables, such as gender and ethnic origin, which may indirectly affect the proposed hypothesis. To enhance the conceptual framework, future researchers could consider incorporating additional variables, such as gender and ethnic origins. This approach would offer a more comprehensive understanding of the potential impact on consumers' adoption of AR shopping. By including such analyses, researchers could reveal important nuances and enhance coverage across different demographic groups.

Finally, future research endeavors should consider expanding the scope to include different geographical regions or countries and using a sampling population of diverse age groups. This broader perspective would enable a more holistic perspective on consumer adoption and acceptance of AR shopping, considering potential cultural, economic, demographic and contextual differences. As AR continues to gain global traction, cross-cultural research can provide more accurate insights into worldwide adoption trends.

7.2 Summary

This study provides a strong rationale for an integrated theoretical framework consisting of TAM and VAM to capture the rational and emotional factors influencing value, engagement and adoption of extended reality. Companies, in turn, understand how the factors influence consumers' adoption of extended reality in online shopping and can roll out marketing activities to address the factors that can either impede or encourage the adoption of the technology which impacts consumers' experience with online shopping.

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Appendix

Perceived Ease of Use (Davis, 1985 and Davis, 1989)

(1) Learning AR to shop will be easy for me.
(2) It will be easy for me to become skillful with AR shopping.
(3) Interacting with AR would require a lot of my mental effort.

Perceived Usefulness (Davis, 1985 and Davis, 1989)

(1) Using AR to shop will increase my productivity.
(2) Using AR to shop will increase my shopping experience.
(3) Using AR to shop will relieve my stress of shopping.

Personalization (Ball *et al.*, 2006)

(1) Using AR to shop offers me products and services that satisfy my specific needs.
(2) Using AR to shop offers me products and services that understand my needs.
(3) Using AR to shop knows offers me products and services that I want.

Perceived Value (Cronin *et al.*, 2000; Zeithaml, 1988)

(1) Overall, I believe that the value I get from AR shopping will be good.
(2) Overall, I believe that I will receive more than I will give up.
(3) Overall, I believe that AR shopping will satisfy my expectations.

Perceived Innovativeness (Hwang *et al.*, 2019)

(1) If I heard about new technology, I would look for ways to experiment with it.
(2) Among my peers, I am usually the first to try out new technologies.
(3) I like to experiment with new information technologies.

Perceived Sacrifice (Ameen *et al.*, 2021)

(1) I think it is unsafe to provide my individual information to the AR shopping platform.
(2) I think it is risky to use AR shopping platform for online transactions.
(3) I think there will be monetary losses when using the AR shopping platform for payment.
(4) I believe that the costs of equipment (e.g. mobile devices) for AR will be high.
(5) I believe that the transaction fees for using AR will be high.
(6) I believe that the communication or access fees for using AR will be high.
(7) I would find using AR more attractive when providers offer bonuses and discounts.

(8) Overall, I believe that using AR will cost me a lot of money.

Intentions (Ajzen, 1991; Han and Hyun, 2017)

(1) I will use AR to shop.

(2) I am willing to use AR to shop.

(3) I am likely to use AR to shop.

Customer Engagement (Vinerean and Opreana, 2021)

(1) Using AR stimulates my interest in learning more about the company and its products.

(2) Time flies whenever I visit this brand's AR because I want to find out more.

(3) I will utilize AR because it captures my attention with useful information.

(4) It seems to me that AR's posts are very useful.

(5) I'm very pleased to use and interact with AR.

(6) I'm very enthusiastic whenever I use AR.

(7) The AR posts that received in my feed are fun.

(8) My emotional attachment to the brand that I interact with in AR is strong.

(9) I'm willing to collaborate in various AR initiatives in developing products/services/features.

(10) I have liked, commented and/or shared different posts on AR.

(11) In general, I feel motivated to actively engage with AR posts on social media.

About the authors

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