USE OF AUGMENTED REALITY-BASED APPLICATIONS IN ONLINE RETAILING AND CUSTOMER ENGAGEMENT: AN EMPIRICAL INVESTIGATION IN THE CONTEXT OF THE EMERGING ECONOMY OF THAILAND

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ABSTRACT

Technological advancements and the widespread use of digital technologies are reshaping retail businesses and the shopping experience. Augmented reality (AR) is digital technology used to create a new retail concept in which a shop's physical and digital components coexist. This study investigated a customer engagement model in the context of online retail business that utilizes AR-based applications. A questionnaire was administered to a sample of 400 customers who have used AR in online shopping. Descriptive data were analyzed using frequency and percentage distributions. Partial least squares regression was also used to analyze structural equation models. The findings indicated that digital service experience impacted customer engagement through hedonic and utilitarian values due to perceived ease of use, social influence, and personal innovativeness, all of which were causative variables. Additionally, the findings showed that perceived risk did not affect the hedonic and utilitarian values, and personal inventiveness did not affect utilitarian value. This research demonstrates the critical importance of understanding the variables influencing customer engagement with online retailers using AR-based applications. The research suggests the use of AR-based applications to online retail entrepreneurs to increase customer engagement.

Keywords: Augmented reality application; Digital retailing; Customer engagement.

INTRODUCTION

The world is completely entering the digital era due to technological advancements and inventions that facilitate everyday tasks, resulting in revolutionary transformations in consumer behavior and corporate processes. For example, a vast customer base increasingly prefers online purchasing over conventional means, resulting in exponential development in the e-commerce sector. Since the outbreak of the COVID-19 pandemic in March 2020, industries worldwide have drastically transformed. Consumer behavior has recently changed profoundly, affecting retailers and suppliers (Laato et al., 2020). Customers in the past have tried goods out in brick-and-mortar locations before making a purchase. The only problem with this argument is that customers have migrated from offline to online purchasing due to the COVID-19 pandemic. They use digital technologies to perform different tasks while shopping online, creating businesses that use the Internet as an integral part of their operations. These businesses meticulously investigate ways to use digital tools to find new vitalities and development (Koay & Muthuveloo, 2021).

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According to a report conducted by the United Nations Conference on Trade and Development (2020), the rapid growth in e-commerce caused by the COVID-19 pandemic boosted online retail sales' proportion to overall retail sales from 16% to 19% in 2020. Furthermore, according to the most recent projections, worldwide e-commerce sales increased by 4% in 2019 to $26.7 trillion (The United Nations Conference on Trade and Development, 2020). Notably, due to quarantine limitations enforced in many countries, the pandemic caused an increase in the demand for online physical products. Consequently, total retail sales in this group of nations fell by 1% in 2020, whereas online retail increased by 22% (The United Nations Conference on Trade and Development, 2020). Thus, this high potential growth is opening up various possibilities for consumers and businesses.

Thailand exemplifies a similar situation. Consumer behavior in the country is changing dramatically due to technical and digital advancements. The resulting rise in commercial Internet transactions is reshaping the country's economic and social perspectives. According to a study conducted by the Electronic Transactions Development Agency (2020), Thais spent an average of 10 h and 22 min online, a considerable rise over the past years. For two consecutive years during this era of Internet usage, purchasing goods and services online was one of the top five most popular activities (Electronic Transactions Development Agency, 2020). As a result, e-commerce transactions increased by 3.15 trillion baht or 8%–10% annually (Electronic Transactions Development Agency, 2020). Business-to-business transactions placed top, totaling 1.5 trillion baht, or 54.49% of overall growth, followed by business-to-consumer transactions, which totaled 0.758 trillion baht, or 27.47% of total growth (Electronic Transactions Development Agency, 2020).

These changes in the business world are creating new possibilities for trade, particularly for businesses considering a transition to online platforms. They build long-term connections with their target market via consumer interaction to accomplish their commercial objectives. This marketing approach has been scrutinized from various perspectives. For example, Hu and Chaudhry (2020) found that e-commerce businesses may connect with their consumers via live broadcasts on social media sites, thus establishing customer loyalty. Baboolal-Frank (2021) observed that Amazon adopted a customer-centric strategy, which is the tool that ensured the success of their organization by harnessing and meeting their customers' needs and wants. In addition, Oduaran and Okorie (2019) recommended that digital media are useful not only in sending out information to the disseminators but also for the audience in promoting customer engagement in the business world. Not even the small and medium enterprises (SMEs) that adopt customer engagement technology to leverage competitive advantage remain customer-centric organizations (Faridi & Malik, 2019). According to Blasco-Arcas et al. (2016), one element that significantly affects the connection between online retailers and consumers is the integration of interactive content into online platforms (Lin et al., 2018).

Augmented reality (AR) is one of several digital technologies that help build a new retail shop concept that integrates traditional and digital store components. AR product lifecycle is at its early stage and may change rapidly over time. Modern interactive environments, in which augmented and virtual items coexist, are created along with other technologies, such as virtual reality and mixed reality (Flavián et al., 2019). The retail industry is commonly perceived to impact AR significantly (Cruz et al., 2019). The AR industry is predicted to be worth $56.8 billion globally by 2020, and retail AR is expected to be worth $7 billion by 2023 (Javornik, 2016). These worldwide statistics support the positive outlook for this technology. Shopping experiences may be transformed through AR (Watson et al., 2018). AR in retail industries is

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increasing as companies have an incentive to use it, mainly to increase online buying, smartphone usage, and the adoption of connected devices. Retailers are also developing AR technologies to engage customers and improve their digital shopping experiences (Watson et al., 2018).

However, research examining how online retailers may increase customer engagement via AR-based applications is limited in the context of Thailand. For example, the search for the keywords "augmented reality" and "engagement" on ThaiJo, Thai Journal Citation Index, and Thai-Lis Digital Collection over 10 years from 2010 to 2020 yielded a few directly relevant results, particularly those relating to tertiary retailing businesses. This present research fills this gap by creating a model for analyzing customer engagement in online retail businesses that use AR-based applications, namely, Chiu et al. (2014) and Xiang et al. (2015) for perceived risk; Chun et al. (2012), Ozturk et al. (2016), and Yang (2010) for perceived ease of use; Ajzen (1991), Bhattacherjee and Lin (2015), and Jackson et al. (2013) for social influence; Hartman et al. (2006) and Noh et al. (2014) for personal innovativeness; Chang (2013), Chiu et al. (2014), and Kim et al. (2013) for hedonic and utilitarian values; Pullman and Gross (2004) and Lusch et al. (2008) for digital service experience; and Chang (2013) and Chiu et al. (2014) for consumer engagement. This study contributes to the extant knowledge by, first, demonstrating how perceived risk, perceived ease of use, social influence, and personal innovativeness directly impact consumer engagement through hedonic value, utilitarian value, and digital service experience. Second, it proposes an AR-based application in a model for online retail businesses. Third, it examines consumer engagement in online retail businesses that utilize AR-based applications in the context of Thailand, an emerging economy. The results of this research will benefit online retailers that use AR-based applications and relevant authorities to increase consumer engagement. Therefore, a lasting competitive edge for companies that operate on digital platforms can be established.

Research Objective

This study aims to develop and investigate a model for examining consumer engagement in online retail businesses that utilize AR-based applications.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Technology Acceptance Model (TAM)

To provide recommendations for the successful introduction of customer engagement in online retail businesses that use AR-based applications, numerous studies have addressed various technological acceptance theories (Blut et al., 2016). The most frequently used theoretical modules include the TAM (Davis, 1989; Davis et al., 1989), the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003), the Unified Theory of Acceptance and Use of Technology (UTAUT2) (Venkatesh et al., 2012), and the Technology Readiness and Acceptance Model (TRAM) (Lin et al., 2007). The suggested model herein is based on the original TAM proposed by Davis et al. (1989). The aforementioned authors also considered external factors, and their significance was recognized (Davis et al., 1989). According to the TAM, perceived usefulness (PU) and perceived ease of use (PEOU) affect technology adoption and usage, and it is also influenced by external variables (Blut et al., 2016; Lai, 2017). When it

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comes to accepting new technologies, the model suggests that people's voluntary intentions toward utilizing them influence their acceptance, whereas their desire to utilize new technologies determines their attitudes and assessments of the usefulness of said technologies. Moreover, the willingness of consumers to put new technologies to use is crucial. As proposed by Parasuraman (2000), the technology readiness index (TRI) is relevant for AR-based applications as it measures "people's tendency to accept and utilize new technologies for achieving objectives in home life and at work." Technology readiness is associated with a positive impression of the utility of a smartphone app in both virtual and augmented environments (Blasko et al., 2020). The TRI comprises optimism, innovativeness, discomfort, and insecurity. Lin et al. (2007) used the TRI and TAM to develop a new TRAM that included perceived usefulness (PU), perceived ease of use (PEOU), and use intention.

Utilitarian And Hedonic Values

Upon reviewing the numerous studies on information systems that discuss the uses and gratifications theory and the theory of planned behavior (Ajzen, 1991), attitudes and satisfaction are found to be important explanatory variables for understanding adoption behavior (Yim et al., 2017; Lee, 2018; Li & Fang, 2019; Rauschnabel et al., 2019; Chen et al., 2020). Pleasure is an experience-specific and transitory concept that is linked to the post-consumption evaluation of a particular event. One distinctive characteristic about a person's attitude is how enthusiastic or negative said person becomes about an offering (Liao et al., 2009). Studies on AR applications have elaborated on the viewpoint of Schwarz (2007) that attitudes are time- and context-bound evaluative judgments that are formed from the available information, although attitudes are sometimes considered a permanent personal disposition (Rauschnabel et al., 2019). Per the findings, the majority of consumers are first-time users of AR shopping applications. Thus, satisfaction and attitude creation are the most important considerations.

Ar in Digital Service Experiential Retailing

Currently, the retail environment is being transformed by innovations in interactive technology that allow merchants to offer customers new entertainment as well as memorable and emotive experiences. Aesthetic pleasure, fun activities, as well as multisensory and emotional inputs in the retail environment can all contribute to consumer spending; this was initially dubbed "hedonic consumption" by Holbrook and Hirschman (1982). Hence, the concept of experiential retailing includes not only the goods but also the entire shopping experience and the pleasure of shopping itself (Holbrook & Hirschman, 1982). Moreover, aesthetics and symbolic or sensory advantages naturally reside at the heart of certain product categories (Lim & Ang, 2008). In terms of product categories, both fashion and cosmetics have a strong experience appeal (Wang et al., 2000; Wade Clarke et al., 2012). Consumers are more hedonically driven while shopping for these types of products (Wade Clarke et al., 2012). Thus, customers who purchase beauty or fashion goods might place a premium on the shopping experience (Park et al., 2006).

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Consumer Engagement

A customer's attitude toward a brand-named app may change as a result of their engagement with a branded app. Customer-brand connection strength may be determined by the resulting brand valency (Scholz & Duffy, 2018). Positivity among consumers is correlated with the value that they perceive themselves as having reaped (Kumar & Kumar, 2019). Evaluating consumer engagement intentions in virtual environments, Verhagen et al. (2015) showed that hedonic and utilitarian advantages influence customer engagement intentions. According to Fang et al. (2017), who used an experiential-cognitive mediation method, psychological engagement impacts behavioral engagement intention both directly and through perceived utilitarian and hedonic advantages. Moreover, Yim et al. (2017) argued that customers have a more favorable attitude toward AR-based mobile technology when they find it helpful or enjoyable.

HYPOTHESIS DEVELOPMENT

Perceived Risk

Perceived risk relates to a consumer's perceptions of the benefit and cost of technology adoption. The perceived level of risk is a significant factor in determining whether or not to embrace technology. Wang and Wang (2010) discovered that perceived risk includes assessing the trade-off between privacy and technology use, resulting in a negative impact on perceived hedonic and utilitarian value. Accordingly, the following hypotheses were proposed:

H1: Perceived risk negatively impacts hedonic value.

H2: Perceived risk negatively impacts utilitarian value.

Perceived Ease of Use

The term "perceived ease of use" refers to a consumer's assumption that AR applications are easy to use and thus require short training (Davis, 1989). Accordingly, PEOU directly impacts hedonic and utilitarian values. Chun et al. (2012) and Yang (2010) illustrated this phenomenon by establishing that PEOU was a causal effect on consumers' evaluation of the utilitarian value of online apps. Thus, the following hypotheses were proposed:

H3: PEOU positively impacts hedonic value.

H4: PEOU positively impacts utilitarian value.

Social Influence

Social influence refers to an external factor resulting in a shift in a consumer's mindset (Ajzen, 1991). For example, Jackson et al. (2013) discovered that people who recognize their social influencers or close friends' new technology usage were easily convinced to have a favorable opinion about the technology. Chun et al. (2012) extended this finding showing that social influence significantly directly impacts consumers' perception of hedonic and utilitarian values. Accordingly, the following hypotheses were developed:

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H5: Social influence positively impacts hedonic value.

H6: Social influence positively impacts utilitarian value.

Personal Innovativeness

Personal innovativeness refers to a consumer's proclivity to rapidly embrace new technology with awareness of the threats of other approaches (Slade et al., 2015). This characteristic is a significant predictor of technology's hedonic and utilitarian values (Noh, 2014) Hartman et al. (2006) substantiated this assertion by demonstrating that improvements in perceived hedonic and utilitarian values are positively associated with personal innovativeness. As a result, the following hypotheses were developed:

H7: Personal innovativeness positively impacts hedonic value.

H8: Personal innovativeness positively impacts utilitarian value.

Hedonic Value

Hedonic value is a consumer's propensity to select an AR application based on the state of feeling elicited by its usage, including its degree of pleasure, utility, and stress reduction. Avcilar and Özsoy (2015) discovered a positive correlation between perceived hedonic value and pleasure with online purchases. Additionally, Mouakket and Al-hawari (2012) found a significant relationship between hedonic value and satisfaction with digital services. Accordingly, the following hypothesis was proposed.

H9: Hedonic value positively impacts digital service experience.

Utilitarian Value

Utilitarian value is the consumers' perceived value of an AR application regarding its capacity to meet their requirements or assist in resolving an issue. Avcilar and Özsoy (2015) and Mouakket and Al-hawari (2012) revealed that perceived utilitarian value is positively associated with digital service experience. In addition, Tajpour and Hosseini (2021) showed that the perceived benefits of social media platforms as tools for connecting and interacting with people have a positive effect on the productivity of an organization, enhance the level of the services of said organization, and create new forms of dynamic and participatory communication. Thus, the following hypothesis was proposed.

H10: Utilitarian value positively impacts digital service experience.

Digital Service Experience

Digital service experience refers to the kind and quality of engagement that a particular digital technology facilitates between a customer and an online entrepreneur, such as real-time communication between them regardless of time and location. Tseng and Chiang (2013) emphasized the importance of this service element in establishing and strengthening customer engagement. Tajpour and Hosseini (2021) found that social relationships have a positive effect

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on the performance of digital startups through the mediation of social media. Quester and Lim (2003) showed that happiness with digital services directly correlates with customer engagement level as shown by favorable service evaluations and a high frequency of service use. Tajpour et al. (2021) noted that the structural dimension of social capital, which is a combination of the relationship between individuals and business units, has a significant relationship with the level of commitment in business development. Wijaya (2017) suggested that customer experience has a positive influence on customer loyalty in the fashion industry.

Consumer Engagement

Consumer engagement refers to the degree to which product and service providers succeed in acquiring and retaining devoted consumers who regularly purchase from and communicate with them through online platforms. These interactions occur as a result of the utility and emotional connection provided by a product or service and the perceived relationship generated by such online communities (Brodie et al., 2011; Lim et al., 2020). Thus, the following final hypothesis was developed.

H11: Digital service experience positively impacts consumer engagement.

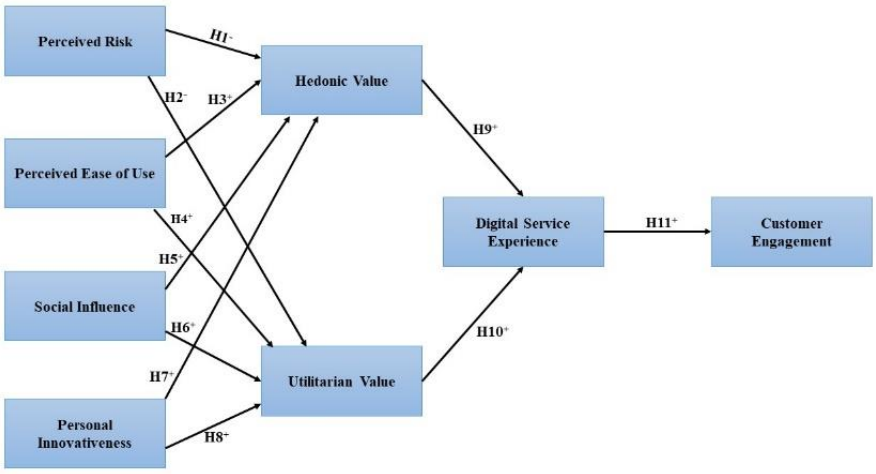

FIGURE 1

CONCEPTUAL MODEL OF THE STUDY

Figure 1 above summarizes the conceptual model for this research based on the literature review.

RESEARCH METHODS

Population and Sample

This study is a quantitative approach to examining customers with previous experience of AR-based applications used by online retailers. Following Hair et al. (2017), the sample size was

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at least 5–10 times larger than the number of indices to be assessed. The smallest acceptable sample is 230 because the questionnaire used for data collection included 23 items. The final size was larger than the smallest acceptable sample size of 400 to prevent impeding statistical calculations due to sampling size determination (Henseler et al., 2016). The sample was selected via purposive sampling.

Research Instrument

The questionnaire used for data collection comprised two sections: 1) demographic information and 2) consumer engagement in online retail businesses utilizing AR-based applications. The first section was gathered using eight questionnaires. The second section assessed perceived risk using three questions adapted from Chiu et al. (2014); Xiang et al. (2015); PEOU using three questions adapted from Chun et al. (2012); Ozturk et al. (2016); Yang (2010); social influence using three questions adapted from Ajzen (1991); Bhattacherjee and Lin (2015), and Jackson et al. (2013); personal innovativeness using two questions adapted from Hartman et al. (2006) and Noh et al. (2014); hedonic and utilitarian values using three and two questions, respectively, adapted from Chang (2013), Chiu et al. (2014), and Kim et al. (2013); digital service experience using five questions adapted from Pullman and Gross (2004) and Lusch et al. (2008); and consumer engagement using two questions adapted from Chang (2013) and Chiu et al. (2014). In the second part, participants used a five-point Likert scale to express their agreement or disagreement with the 23 questions, ranging from "1 = strongly disagree" to "5 = strongly agree."

Validity and Reliability of the Research Instrument

Three experts assessed the questionnaire's content validity using the item-objective congruence technique. Rovinelli and Hambleton (1976) established 0.50 as the minimum acceptable score, showing congruence between the questionnaire items and the study objectives. The analysis results revealed that all questions met the criteria, with scores between 0.67 and 1.00. The questionnaire was then piloted on 30 participants to determine its Cronbach's alpha coefficient. Following Hair et al. (2017), the minimum acceptable reliability coefficient was established at 0.70. Eight variables passed the criteria, with scores ranging from 0.732 to 0.902, whereas one failed and was therefore eliminated. The questionnaire was administered to 400 participants after its final revision.

Data Collection

A link to the questionnaire was established on social networking websites, such as WeLoveShopping, Pantip, and the IKEA fan page, to gather data. The link has been configured to be available for responses from September 16, 2020, to October 5, 2020. To ensure that only subjects who met the research objective were included, the first demographic information question inquired about respondents' prior experience with AR-based applications. These applications combine the real and virtual worlds and project interactive 3D images onto consumers' devices, such as smartphones and tablets, for real-time online purchase transactions. Individuals who responded negatively to the question were eliminated.

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Data Analysis

The data were distributed normally to verify that no data or outliers were missing. In addition, linearity, multicollinearity, and singularity problems did not exist. The returned questionnaires were subjected to a preliminary statistical assumption test. The findings indicated that the data matched these requirements, with a left-skewed distribution ranging from +3 to −3. Then, the data were analyzed using descriptive statistics and a partial least squares structural equation modeling (PLS-SEM) technique to ascertain the participants' demographic profile and the variables' causal relationships, respectively. PLS was chosen rather than hierarchical component models (such as second-order constructs) as the prediction method because of its advantages (Hair et al., 2016). Finally, the consistency of the structural equation was produced and the empirical data were determined using the SmartPLS 3.0 software.

RESULTS

Demographic Information

In total, 83.60%, 99.60%, 75.60%, 94.70%, 39.40%, and 40.20% of the participants were female, aged between 18 and 25 years, had a bachelor's degree, earned a monthly allowance between 5,000 baht and 10,000 baht, had 3 years of experience buying goods and services online, and preferred IKEA Place as their AR shopping application, respectively. However, only 47.10% of the respondents reported spending an average of 501–1,000 baht on each Internet transaction.

Assessment of the Measurement Model

The examination of internal consistency reliability revealed that all latent variables had a composite reliability value of more than 0.708 and a Cronbach's alpha coefficient greater than 0.70, indicating their reliability (Hair et al., 2017). Furthermore, convergent validity analysis revealed an average variance extracted (AVE) value greater than 0.50 for all latent variables, indicating that the manifest variables are related to the same latent variables (Hair et al., 2017). Additionally, the indicator reliability revealed that the outer loading coefficient for all manifest variables was more than 0.70, indicating that all manifest variables in the model were reliable (Hair et al., 2017). Finally, Dijkstra and Henseler (2015) suggested Rho_A as an alternative measure for assessing dependability. All constructs in our research had Rho_A values greater than 0.70, suggesting construct reliability. Table 1 below summarizes the findings.

TABLE 1
CONSTRUCT VALIDITY

Constructs and Items	Factor Loading	Cronbach's Alpha	Rho_A	CR	AVE
Digital service experience	-	0.897	0.898	0.924	0.709
DE1	0.787				
DE2	0.861				
DE3	0.878				
DE4	0.831				
DE5	0.851				
Customer engagement	-	0.840	0.849	0.926	0.862
CE1	0.937				

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CE2	0.919				
Perceived ease of use	-	0.785	0.789	0.874	0.699
EU1	0.837				
EU2	0.819				
EU3	0.851				
Hedonic value	-	0.778	0.787	0.871	0.693
HV1	0.798				
HV2	0.812				
HV3	0.885				
Personal innovativeness	-	0.733	0.739	0.882	0.789
PI1	0.902				
PI2	0.874				
Perceived risk	-	0.776	0.891	0.862	0.677
PR1	0.772				
PR2	0.890				
PR3	0.802				
Social influence	-	0.841	0.847	0.904	0.759
SN1	0.831				
SN2	0.898				
SN3	0.883				
Utilitarian value	-	0.818	0.818	0.916	0.846
UV1	0.917				
UV2	0.922				

Discriminant validity analysis revealed that the AVE square root of each latent variable was greater than the correlation coefficients between that latent variable and the other variables in the model. Furthermore, the analysis revealed that the cross-loading correlation between each manifest variable and the corresponding latent variable was greater than that between the manifest variable and the other latent variables. This result indicated that all latent variables in the model had acceptable discriminant validity and were quantified using valid manifest variables (Fornell & Larcker, 1981). Table 2 below summarizes the findings.

TABLE 2
DISCRIMINANT VALIDITY WITH THE FORNELL–LARCKER CRITERIA

Constructs	**Fornell–Larcker Criterion**							
	DE	CE	EU	HV	PI	PR	SN	UV
DE	**0.842**							
CE	0.757	**0.928**						
EU	0.681	0.694	**0.836**					
HV	0.651	0.616	0.678	**0.833**				
PI	0.631	0.654	0.603	0.525	**0.888**			
PR	0.145	−.1456	0.043	0.118	0.124	**0.823**		
SN	0.666	0.694	0.674	0.607	0.618	0.059	**0.871**	
UV	0.538	0.607	0.623	0.600	0.505	0.003	0.560	**0.920**

Note: The square roots of the AVE values are presented in bold type along the diagonal cells.

Additionally, Dijkstra and Henseler developed the heterotrait–monotrait correlation ratio (HTMT), where values less than 0.90 consistently differentiate latent variable validity (Dijkstra & Henseler, 2015). As demonstrated in Table 3, all values in our research reached significant

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criteria. In summary, our conceptual model demonstrated adequate reliability, construct validity, and discriminant validity for the measurement model.

TABLE 3
DISCRIMINANT VALIDITY WITH THE HETEROTRAIT–MONOTRAIT RATIO

Constructs	Heterotrait–Monotrait Ratio							
	DE	CE	EU	HV	PI	PR	SN	UV
DE								
CE	0.868							
EU	0.813	0.852						
HV	0.777	0.752	0.859					
PI	0.779	0.832	0.790	0.686				
PR	0.162	0.077	0.129	0.163	0.139			
SN	0.765	0.822	0.825	0.744	0.784	0.063		
UV	0.628	0.731	0.774	0.749	0.651	0.090	0.671	

Assessment of the Structural Model

The evaluation of a structural model requires multicollinearity testing, the absence of statistically significant connections between predicted variables, and a variance inflation factor (VIF) value of less than 3.30 (Hair et al., 2017). Table 4 below shows that the predicted variables' VIF values are consistent with the stated criteria, indicating that the requirements were met.

TABLE 4
STANDARD ASSESSMENT CRITERIA OF THE STRUCTURAL MODEL

Constructs	VIF
DE1	1.870
DE2	2.710
DE3	2.956
DE4	2.293
DE5	2.397
CE1	2.102
CE2	2.102
EU1	1.696
EU2	1.582
EU3	1.644
HV1	1.640
HV2	1.504
HV3	1.982
PI1	1.502
PI2	1.502
PR1	1.585
PR2	1.519
PR3	1.829
SN1	1.743
SN2	2.270
SN3	2.180
UV1	1.916
UV2	1.916

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To assess the statistical significance of the structural model created using the PLS-SEM approach, a two-tailed hypothesis test was conducted using the bootstrapping method (Hair et al., 2017) and repeated sampling of 5,000 datasets (Hair et al., 2017). The significance level was set at 0.05 or $p<0.05$. Moreover, the t-value was set to higher than or equal to 1.96 or $t \geq 1.96$. Furthermore, our PLS findings supported H3–H6 and H8–H11 but rejected H1, H2, and H7. Table 5 and Figure 2 below summarize the hypothesis test results.

TABLE 5
PATH COEFFICIENT RESULTS

No	Paths	β	Mean	SD	T-values	Result
H1	Perceived risk --> Hedonic value	0.072	0.082	0.041	1.749	Rejected
H2	Perceived risk--> Utilitarian value	−0.044	−0.044	0.038	1.147	Rejected
H3	Perceived ease of use --> Hedonic value	0.460	0.459	0.053	8.717***	Accepted
H4	Perceived ease of use --> Utilitarian value	0.402	0.402	0.051	7.929***	Accepted
H5	Social influence --> Hedonic value	0.234	0.238	0.055	4.228***	Accepted
H6	Social influence --> Utilitarian value	0.203	0.199	0.055	3.710***	Accepted
H7	Personal innovativeness --> Hedonic value	0.095	0.092	0.049	1.941	Rejected
H8	Personal innovativeness --> Utilitarian value	0.142	0.143	0.046	3.064**	Accepted
H9	Hedonic value --> Digital service experience	0.512	0.514	0.048	10.596***	Accepted
H10	Utilitarian value --> Digital service experience	0.231	0.231	0.056	4.140***	Accepted
H11	Digital service experience --> Customer engagement	0.757	0.758	0.024	31.349***	Accepted

Notes: ** and *** indicate statistical significance at $p < 0.01$ (t-value ≥ 2.576) and $p < 0.001$ (t-value ≥ 3.291), respectively.

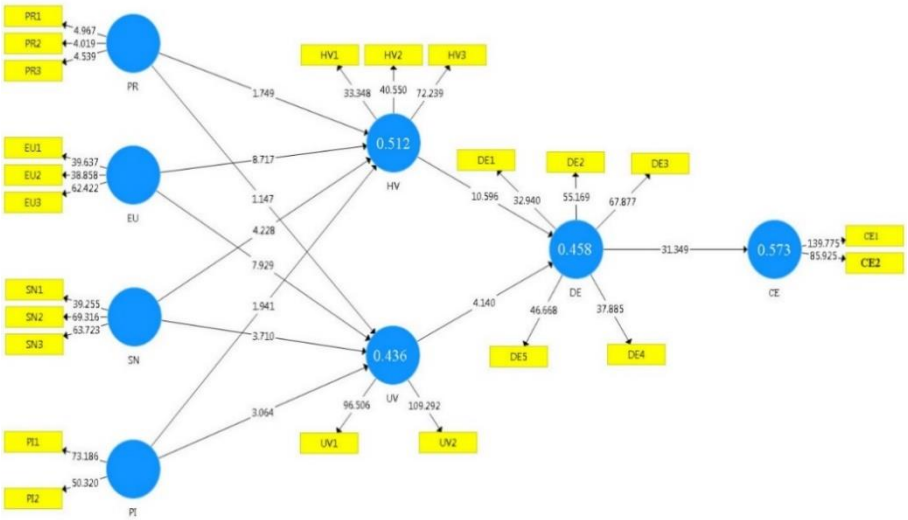

FIGURE 2

BOOTSTRAPPING PATH COEFFICIENT RESULTS

Table 6 below demonstrates that the factor with the greatest total effect (TE) on consumer engagement was digital service experience (TE = 0.757), followed by hedonic value (TE = 0.388), PEOU (TE = 0.249), utilitarian value (TE = 0.175), social influence (TE = 0.126),

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personal innovativeness (TE = 0.062), and perceived risk (TE = 0.020). Additionally, the combined prediction accuracy of all variables (R^2) in forecasting consumer engagement in online retail businesses utilizing AR-based applications was 57.30%, and the predictive relevance between the factors (Q^2) was greatly high, at 0.469.

TABLE 6
DIRECT (DE), INDIRECT (IE), AND TOTAL (TE) EFFECTS OF THE INDEPENDENT VARIABLES

Latent Variables	Q^2	R^2	Effects	Antecedents						
				PR	EU	SN	PI	HV	UV	DE
HV	0.329	0.512	Direct	0.072	0.460	0.234	0.095	0.000	0.000	0.000
			Indirect	0.000	0.000	0.000	0.000	0.000	0.000	0.000
			Total effect	0.072	0.460	0.234	0.095	0.000	0.000	0.000
UV	0.349	0.436	Direct	−0.044	0.402	0.203	0.142	0.000	0.000	0.000
			Indirect	0.000	0.000	0.000	0.000	0.000	0.000	0.000
			Total effect	−0.044	0.402	0.203	0.142	0.000	0.000	0.000
DE	0.303	0.458	Direct	0.000	0.000	0.000	0.000	0.512	0.231	0.000
			Indirect	0.027	0.328	0.167	0.081	0.000	0.000	0.000
			Total effect	0.027	0.328	0.167	0.081	0.512	0.231	0.000
CE	0.469	0.573	Direct	0.000	0.000	0.000	0.000	0.000	0.000	0.757
			Indirect	0.020	0.249	0.126	0.062	0.388	0.175	0.000
			Total effect	0.020	0.249	0.126	0.062	0.388	0.175	0.757

Notes: $R^2 \geq 0.25$, $R^2 \geq 0.50$, and $R^2 \geq 0.0.75$ demonstrate a low, moderate level, and high level of predictive power, respectively (Hair et al., 2017). $Q^2 \geq 0.02$, $Q^2 \geq 0.15$, and $Q^2 \geq 0.35$ demonstrate a low, moderate, and high degree of correlation, respectively (Hair et al., 2017).

DISCUSSION

Several interesting issues were identified regarding the use of AR-based applications in online retailing and customer engagement in the context of Thailand, which are as follows. To begin with, the results presented above are the first to illustrate that PEOU is the most probable causal factor contributing to hedonic value regarding customer engagement in online retail businesses that utilize AR-based applications. Moreover, substantial prior research supports this psychological propensity. For example, Avcilar and Özsoy (2015) found a relationship between PEOU and customers' perceptions of hedonic value. Furthermore, Ozturk et al. (2016) generated a more precise conclusion that PEOU and social influence are likely the most important variables influencing the hedonic value of customer experience when buying online through mobile devices. In comparison, Yu et al. (2018); Luo and Ye (2019); Altalhi (2020) acknowledged the importance of PEOU and social influence. However, their findings differ slightly, indicating that not only these two factors but also personal inventiveness are significant predictors of consumers' perceptions of hedonic and utilitarian values (Al-Jundi et al., 2019) for corroborative evidence of the effect of personal innovativeness).

In addition to PEOU, the current results indicate that perceived hedonic value is likely to be the most significant antecedent to the creation of digital service experiences. For example, Moghadamzadeh et al. (2020) revealed that customer participation behavior on social media platforms positively affects the rendering of innovative services. Moreover, Chiu and Cho (2019) asserted that customers with a positive experience of an e-commerce service are more likely to be satisfied with the service's quality and desire to repurchase. Further, according to

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Papagiannidis et al. (2017), Yu et al. (2018), and Vijay et al. (2019), in addition to hedonic value, consumers' perceived utilitarian value may also contribute to their different digital service experiences from online retailers and commercial social media platforms.

Finally, the results herein indicate that a positive digital service experience is associated with increased consumer engagement in retailers that utilize AR-based applications. This finding is consistent with that of Asfahani (2021), who showed that customers make more use of online ordering and shopping, mobile payments, and shopping via mobile apps when satisfied with CRM strategies, which can enhance customer engagement, maintain relationships with customers, and retain their loyalty. Moreover, Wijaya (2017) found that customer experience has a positive influence on customer loyalty in the fashion industry. In addition, Wu and Stilwell (2018) asserted that an excellent digital service experience contributes to building and maintaining customer loyalty. Similarly, Ngo et al. (2019) demonstrated a potential direct relationship between a good experience with a service obtained through a particular technology and customer engagement with the technology, which likely leads to frequent repurchases (Lim et al., 2020).

Nevertheless, several unexpected results emerged from this research. First, perceived risk may have a slight impact, if any, on hedonic and utilitarian values. Second, personal inventiveness and hedonic value do not show any relationship. Such occurrences are common in the present literature. For instance, Chakraborty and Soodan (2019) demonstrated that a consumer's perception of risk associated with technology is unlikely to predict their perception of its hedonic value, whereas Riek et al. (2016) showed that a relationship does not exist between perceived risk and utilitarian value or between personal innovativeness and hedonic value, which is also illustrated in Krey et al.'s (2019) investigation on smartwatch users.

CONCLUSION

The key points of this empirical research on using AR-based applications in online retailing and customer engagement in Thailand, an emerging economy, can be summarized as follows. PEOU and social influence factors are positively correlated with hedonic value. And the factors of PEOU, social influence, and personal innovativeness. There is a positive correlation and impact on the utilitarian value. Hedonic and utilitarian values have a positive correlation and impact on the digital service experience. Specifically, the digital service experience has a positive correlation and impact on customer engagement. However, perceived risk has no relationship and a negative impact on utilitarian value, and personal innovativeness has no positive correlation and no impact on hedonic value. Therefore, those implementing AR-based applications in online retailing to enhance customer engagement in Thailand should focus on designing applications to be intuitive by using advertising featuring famous societal figures or referrals from friends and on designing work systems that are modern and usable to attract customers. This will allow customers to realize the benefits to be gained from using AR-based applications when shopping from online retailing businesses and to feel satisfied with using such applications. In addition, such designs would result in customers being satisfied with their experiences with AR-based applications, which could lead to an increase in customer brand engagement in online retailing.

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RECOMMENDATIONS

Theoretical Implications

Based on the results herein, a model that can be used to examine consumer engagement in online retail businesses that utilize AR-based applications was created. The TAM, concepts of utilitarian and hedonic values, concepts of AR in digital service experiential retailing, and concepts of consumer engagement can be applied as frameworks for studying consumer engagement in online retail businesses that utilize AR-based applications. The present research is consistent with previous studies. In addition, the results of this investigation can be used as a guide for further studies to enhance digital service experience, which has a significant influence on consumer engagement through emotional and utilitarian values. Ease of use, social influence, and personal innovation ability are perceived as causal factors, although other factors likely also exist. In particular, the statistical analysis showed that the R^2 of the factors that directly affect the model for examining consumer engagement in online retail businesses that utilize AR-based applications was 0.573; namely, this value can explain 57.30% of the variance of the dependent variable. Thus, other than those identified in this research, as much as 42.70% of the variance might be explained by other variables that can be used to describe consumer engagement in online retail businesses that utilize AR-based applications.

Application of the Findings

This study indicates that PEOU and social influence positively affect hedonic value. This mechanism also collaborates with personal innovativeness to determine digital service experience while shopping online through a mobile device. Therefore, online retailers and other entrepreneurs are recommended to create a simple application that allows customers to explore product and service information and make intelligent selections promptly. Additionally, the application can be promoted via advertising or sponsorship by a celebrity.

The current results show the combined impact of hedonic and utilitarian values on customers' evaluation of digital service experiences. Accordingly, the following suggestions are generated for online retailers and other relevant entrepreneurs. First, the display of product or service information on an application should be unexpected and designed with care. To further increase the application's hedonic value, it may use a gamification approach, making accessible games that customers may play while shopping or enter to win rewards. Finally, regarding utility, the application should have various features, such as real-time order processing notifications and interactive messaging. These features can guarantee that customers are updated on their orders. All these recommendations will help differentiate virtual shopping from conventional modes of commerce and pave the way for online retailers using AR technology to succeed.

Finally, the research findings demonstrate a positive relationship between customer engagement and digital service experience. Thus, online retailers and other stakeholders are encouraged to obtain a competitive advantage by using the capabilities of AR technology to design their services. As stated, this approach includes the integration of real-time order processing notice and interactive messaging features. However, regardless of how sophisticated an AR application is, it must be user-friendly and adaptable to customers with varying degrees of

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technical knowledge. These conditions are necessary for establishing customer engagement and therefore brand loyalty.

FUTURE RESEARCH

A mixed-method approach, including quantitative and qualitative research, should be used to provide additional comprehensive findings that shed light on how customers' psychological behavior influences their interaction with online retailers providing goods and services through AR applications. For example, a qualitative approach may use focus group interviews or other relevant techniques. In addition, further studies should include additional variables that are likely to affect consumer engagement, such as buying power, quality expectations, brand loyalty, and the alignment of self-image and brand identification.

INSTITUTIONAL REVIEW BOARD STATEMENT

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Human Research Ethics Committee of Silpakorn University (COE number: COE 63.0917-077 and date of approval: September 17, 2020).

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