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Article

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MARKETING | RESEARCH ARTICLE

Immersive experience and customer responses towards mobile augmented reality applications: The moderating role of technology anxiety

Kim Nhan Vo^{1*}, Angelina Nhat Hanh Le², Le Thanh Tam³ and Huong Ho Xuan⁴

Abstract: The purpose of this study is to investigate the impact of customer immersive experience on attitude and adoption intention toward mobile augmented reality applications (MAR apps). This paper also examines the moderating role of technology anxiety on the relationship between immersive experience on attitude and adoption intention toward MAR apps. A dataset of 322 customers and the partial least square structural equation model (PLS-SEM) with the SmartPLS 3.2.8 statistical software were used to test the proposed hypotheses. The results show that immersive experience significantly affects attitude and adoption intention toward MAR apps. In addition, the vital role of technology anxiety in moderating the relationship between customer immersive experience and their responses toward MAR apps is revealed.

Subjects: Marketing; Customer Behavior

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PUBLIC INTEREST STATEMENT

This study provides a more understanding of using mobile augmented reality applications (MAR apps) as an emerging marketing tool. This paper also investigates empirically the impacts of immersive experience on attitude and adoption intention toward MAR apps. In addition, the current research examines the moderating role of technology anxiety on the relationship between customer immersive experience and their responses toward MAR apps. Drawing on the findings mentioned above that clarify how MAR apps can be an interactive technology for markets related to immersive experience, attitude, adoption intention, and technology anxiety, this study provides the managerial implications for retailers and customers.

Keywords: customer immersive experience; attitude; adoption intention; mobile augmented reality applications; technology anxiety

1. Introduction

In recent years, consumers have pervasively changed from shopping at traditional stores to internet shopping due to the global COVID-19 pandemic (Alimamy & Gnoth, 2022; Al-Hattami & Gomez Corona, 2021). The pandemic makes a huge transformation in the global business landscape (Irawan et al., 2020) in which technology devices as mobile applications have been largely used in shopping online (Fernandes et al., 2020). Mobile augmented reality applications (MAR apps) is an emerging technology affecting multiple sectors (research, industry, education, tourism, advertising and retailing, entertainment, etc.) because of their potential benefits (Daniel & Berinyuy, 2010; Hilken et al., 2018; Javornik et al., 2022). Hsu et al. (2021) indicated that AR-based sales have increased from more than \$12.0 billion in 2020 to \$72.8 billion in 2024. Emerging technologies as MAR apps have changed the world and how people contact each other. This technology has been more popular because of its interactive features (Lu & Smith, 2007) and has various options for customers (Kim & Forsythe, 2008a). Customers can try on and experience virtual augmented reality products, then they evaluate which are the best products suitable for their demands before making decisions. In recent years, many companies have applied augmented reality (AR) in creating more informative and fully interactive products to suit their customer demands (Zubizarreta et al. 2008a). Many organizations have applied AR technologies in their mobile phone applications, i.e. YouCam, IKEA catalog (Alimamy & Gnoth, 2022; Javornik et al.). This “magic mirror” transforms customers’ shopping experience by allowing them to understand products that they are going to purchase from different aspects and options. According to Moorhouse et al. (2018), an emerging technology such as MAR apps is the latest technological innovation that may revolutionize consumer behaviors. From above arguments, it is likely that MAR apps is a potential and effective marketing tool in all markets, especially in developing markets as Vietnam.

In a marketing context, previous studies have demonstrated that AR technologies can be applied in order to enhance customer immersion (Georgiou & Kyza, 2017; Hilken et al., 2018; Hudson et al., 2019; Yim et al.). Mekni and Lemieux (2014) stated that MAR apps can provide attractive and informative virtual products in order to make customers satisfied. This technology can also give customers additional information about the products (Baier et al., 2015) before making purchasing decisions (Javornik, 2016; Pantano et al.). Virtual glasses can be used to create added value for customers and impact their perception (Oyman et al., 2022; Verhagen et al., 2014). In addition, virtual make-up mirrors compliment users and make them enjoyable. In a retailing context, there is an enormous change in customer cognition and behavior thanks to AR technologies (Mauroner et al. 2022). The application of AR technologies can be more beneficial for customers via mobile apps or virtual try-on websites (Dacko, 2017) because when being immersed in virtual products via MAR apps, customers can be intensively enhanced in their positive emotions, as well as cognitive and affective responses (Rese et al., 2017).

The emerging technologies like AR have been promoted in a number of developed markets (Jessen et al., 2015; Oyman et al., 2022; Qin et al., 2021). Applying virtual technologies like AR to facilitate consumer immersive experience should help companies achieve their goals successfully (Heller et al., ; Hilken et al., 2018). However, whether and how customers’ immersive experiences impact on attitude and adoption intention toward MAR apps in the context of developing markets such as Vietnam has largely been ignored. Thus, first of all, the research gap that this study would like to address is to investigate the crucial role of immersive experience in facilitating both attitude and adoption intention toward MAR apps among Vietnamese consumers. The nature of immersive experience that is enabled by MAR apps is thoroughly discussed, and the mediating role of attitude toward MAR apps on the relationship between immersive experience and the adoption intention of MAR apps is also further scrutinized in this study. In addition, consumers might possess different

personal tendencies regarding general technologies that affect their perceptions, evaluations, and preferences pertaining to MAR technologies. Technology anxiety refers to a personal state of nervous concern an individual experiences while using technology devices (Meuter et al., 2003; Oyman et al., 2022). Yang and Forney (2017) has demonstrated the moderating effect of technology anxiety on the relationship between customer expectations and the intention to use mobile shopping. A high level of the fear of using MAR apps would cause consumers to avoid adopting emerging technologies such as MAR apps and vice versa (Li & Xu, 2020). Therefore, consumers' technology anxiety is integrated as a moderating variable in our research model.

In short, this study contributes to the existing literature by (1) investigating the impacts of consumer immersive experience when using try-on MAR apps on both their attitude and adoption intention, (2) scrutinizing the mediating role of attitude toward MAR apps on the relationship between immersive experience and adoption intention, and (3) examining the moderating role of technology anxiety on the relationship between immersive experience and its two outcomes. The empirical findings will provide valuable guidance for business and retailing practitioners to properly apply and effectively utilize immersive-experience-enabled technologies such as MAR apps that can facilitate customer's attitude toward MAR apps and eventually boost their adoption intention.

2. Literature review and hypotheses development

2.1. Customer's immersive experience with MAR apps

Researchers have defined immersion in different ways based on contextual environments, such as education (Radianti et al., 2020), tourism (Hudson et al., 2019; Tsai, 2020), retailing (Peukert et al., 2019; Song et al., 2019) because of its amazing potentials (Daniel & Berinyuy, ; Hilken et al., 2018). From the technological perspective, immersion is often used to describe the level of media' quality (Flavián et al., 2019). According to the study of Suh and Prophet (2018), immersive technology is technology (e.g., augmented reality, virtual reality) that offers the user immersive experiences while using the technology. From a psychological perspective, Brown and Cairns (2004) stated that immersion is a multi-dimensional psychological state explained by the flow theory of Csikszentmihalyi (1988), such as engagement, engrossment, and total immersion. Later on, Carù and Cova (2006) also explained that immersion refers to the user experience, such as engagement, engrossment, and total immersion. Having the relationships between technical and human psychological states, Hilken et al. (2018) argued that immersion was influenced by user personality traits through user experience using new technology as AR. Weibel et al. (2010) also stated that immersion can be understood as a natural psychological state, engaging in an engrossing and certain activity. Moreover, Witmer and Singer (1998) explained that immersion refers to a psychological state of having attachment with an environment that provides stimuli and experiences. On the other hand, immersion is considered as a state of consciousness where the physical self is lost by being surrounded by the environment and can be categorized into tactical, strategic, narrative, spatial, cognitive, sensory, psychological, and emotional immersion (Parvinen et al., 2015). Yim et al. (2017) defined customer immersion as the levels of user feeling which were absorbed in, involved with, and engrossed in virtual environment.

In social perspective, Carù and Cova (2007) argued that immersion is a process of accessing an experience through which a consumer becomes one with the experience by being immersed in a secure spatial environment. In experience economy perspective, Pine et al. (2021) argued that immersion is considered as a physical or virtual apart of the experience. Agarwal and Karahanna (2000) stated that immersion is a dimension of cognitive absorption which is able to enhance and shape user attitude, adoption intention. In recent studies, immersion has different states including engagement, engrossment, and total immersion based on cognitive and affective human experience (Georgiou & Kyza, 2018). In the current studies, the customer immersion concept was examined as a customer's immersive experience in virtual environments (Hansen & Mossberg, 2013; Hudson et al.). Immersion is considered as deep involvement in the present. Song et al.

(2018) also showed that immersion is a human psychological state of deep involvement with technological devices. In related immersion concepts, Blumenthal and Jensen (2019) suggested three levels of involvement, namely, involvement triggers, involvement worlds and a state of immersion.

Common to all these definitions is the customer immersive experience described by the user's deep involvement and immersive experience in the present moment (Georgiou & Kyza, 2018, ; Hansen & Mossberg, 2013; Yim et al.). In this study, immersion concept can be defined as customer immersive experience absorbed in, involved with, and engrossed in virtual environment (Georgiou & Kyza, 2018; Song et al., 2018; Yim et al.). In general, while customer immersion has been viewed as an individuals' experience focusing on unidimensional construct or multidimensional construct (Hudson et al., ; Song et al., 2018; Yim et al.).

2.2. Attitude and adoption intention toward MAR apps

Attitude refers to an individual's feeling or opinion about performing a particular behavior (Ahmad & Abdulkarim, 2018; Azjen, 1980). Attitude toward MAR apps in the current study is considered as customers positive or negative feelings about using MAR apps. Ryan and Deci () argued that human behavior is driven by individual and external motivational factors, so a positive attitude leads to a high motivation to have adoption intention. Moreover, the technical acceptance model (Davis,) and theory of planned behavior (Azjen, 1980) also explains the relationship between attitude and adoption intention, so customers' attitude toward MAR apps can lead to customers' adoption intention using MAR apps. As mentioned above, immersive experience refers to an individual's internal psychological states, which were engaged in, involved with, and engrossed in virtual environment (Yim et al.), so immersive experience can lead to attitude and adoption intention regarding MAR apps. Thus, attitude toward MAR apps will be influenced by internal human states, which we refer to as immersive experience in this study, then lead to the intention to use MAR apps. Thus, we expect that attitude might play an intermediate role in the relationship between immersive experience and intention to use MAR apps:

Hypothesis 1: Immersive experience is positively related to customers' attitude toward MAR apps

Hypothesis 2: Attitude toward MAR apps positively affect their adoption intention toward MAR apps.

Behavioral responses, which are outcomes of cognitive and affective responses, refer to conviction or intention for human behavior (Suh & Prophet). Prior research indicates that affective responses (i.e. enjoyment) directly positively influence the intention to use MAR (Yim et al.). Kowalczyk et al. (2021) also stated that affective responses (i.e. immersion) have a direct impact on behavioral responses (i.e. reuse intention) using MAR app. After virtual try-on MAR apps, customers intend to use this MAR apps in their shopping in the future. In this study, the behavioral intention is considered as the adoption intention or to continue using MAR apps. In light of the above analysis, the following hypotheses in this study were proposed:

Hypothesis 3: Immersive experience will lead to adoption intention toward MAR apps

2.3. Moderating role of technology anxiety

As above mentioned, technology anxiety is considered as an individual trait reflecting an anxious or emotional state when considering use or actually using technology (Meuter et al., 2003; Oyman et al., 2022; Venkatesh et al., 2014). A person with a high level of anxiety for using MAR apps can have a reduced adoption intention to try on virtual technologies as MAR apps. A high level of technology anxiety has impact on consumer attitudes and can cause them to avoid adopting new technologies

(Li & Xu). Customers with high level of anxiety will be less likely to adopt MAR apps than customers with low level of anxiety. Yang and Forney (2017) also proposed a moderating effect of technology anxiety on the relationship between expectations and the intention to use mobile shopping. Therefore, customers with high technology anxiety are not ready to spend more time trying on MAR apps-based products and vice versa. Based on the discussion above, technology anxiety moderates the relationship between immersive experience and its outcomes.

Hypothesis 4: Technology anxiety positively moderates the relationship between immersive experience and (a) attitude toward MAR apps, (b) adoption intention regarding MAR apps.

3. Method

3.1. Sampling approach

Participants, who have not used MAR apps yet, were chosen to avoid previous effects (Daassi & Debbabi, 2021). They were asked to download two fashion MAR apps (Nikhashemi et al., 2021), namely “YouCam Makeup” and “FormexTryOn” (Daassi & Debbabi, 2021; Song et al., 2018) which were selected for this survey. “YouCam Makeup” app was mainly interesting to young females (Daassi & Debbabi, 2021), whereas the Formex watch app has no sex bias, which means that both males and females can try it on (Qin et al., 2021; Song et al., 2018). Authors suggested two different MAR apps to diversify participants’ choice, avoid sex bias, and increase generalizability in the current study (Daassi & Debbabi, 2021, Rauschnabel et al., 2019). In previous studies (Daassi & Debbabi, 2021; Park and Yoo, 2020; Wang et al., 2021), “YouCam Makeup” app was chosen for their survey and experiment studies. This app has developed to allow users to virtually try on thousands of shades of eye shadows, lip colors, and eye lash styles on their own reflections. To use the app, participants were asked to download “YouCam Makeup” app on their smartphone. Then they could visit the app, select a range of different cosmetic products they were interested in, such as lipstick colors, eyeliner, blush, and eyeshadow to try on. If customers did not want to “try on” the makeup themselves, they could select a model with a similar skin tone and see what the makeup looked like on them (Daassi & Debbabi, 2021). Likewise having been developed by a Swiss watch company, “Formex TryOn” application provides customers with a try-on experience (Song et al., 2018). This app allows users to try on a Formex watch on their wrist, and can change straps and models of Formex watch. It seems that most people tend to be more than happy to answer questions if respondents selected are informed about the objectives, time of survey. Then they can experience MAR apps and answer the questionnaire.

3.2. Sample and data collection

The method of collecting data was convenient to sampling in Ho Chi Minh city, Vietnam. Customers going shopping at supermarkets in Ho Chi Minh city were chosen because Ho Chi Minh City is the largest/busiest city and the commercial hub of Vietnam. E-commercial platforms have also dramatically increased. Tp. Ho Chi Minh City has the highest average income per month compared to other regions of Vietnam (Vietnam E-business Index, 2021) and the highest e-commerce development index (Vietnam E-business Index, 2021). Because of a data bias of online surveys, this study conducted the survey by face-to-face. The respondents were asked directly for AR try-on experience, then completed the survey. Participants were encouraged to describe their own experiences when using AR try on websites or mobile applications. Therefore, Ho Chi Minh city was chosen to conduct research samples. Up to now, prior research relevant to augmented reality technology remain limited. Because the latest AR technology was not popular yet, Ho Chi Minh City was chosen for conducting the main survey with convenient sampling from 450 people aged from 15 years onward.

3.3. Procedure

There are three main steps consisting of fifteen minutes introduction, letting participants try on MAR apps for twenty minutes and completing the survey in ten minutes, with a five minute break among steps (Georgiou & Kyza, 2017; Kowalczyk et al., 2021; Sung, 2022). In the first step, a set of instructions about how to use MAR apps as well as some benefits of MAR apps were given. Then, participants were required to download two suggested fashion apps, namely “YouCam Makeup” and “Formex TryOn” on their smartphone for Android or iPhone. Next step, participants were asked some screening questions by multiple choice to ensure set criteria suitable for the study, such as being willing and understanding the instructions, difficulties with downloading MAR apps, then respondents spent fifteen minutes for virtual try-on, providing an incomplete response (Jessen et al., 2015; Rauschnabel et al., 2019). In the final step, participants were asked to complete the questionnaire and receive a research credit for their participation (Flavián et al., 2017). In some cases, respondents can be given extra time for their participation. In order to collect the data, ten data collectors were recruited and trained in the above-mentioned steps to ensure data collection suitable for the study’s purpose. These collectors were given a financial incentive to motivate their data collection (Nikhashemi et al., 2021). Certainly, the questionnaire was designed to control data collectors and respondents in the period of data collection. All subjects were asked to meet the criteria to ensure compliance with suggested and controllable requirements (Shin and Jeong, 2021). For instance, “Have you ever used an app to virtually try on products, such as clothes, makeup, or eyeglasses, etc.?” to check whether respondents have had prior experiences with virtual try-on apps (Feng and Xie, 2019; Nikhashemi et al., 2021). The purpose of the main study is to evaluate the measurement model and structural model by PLS-SEM tool. Evaluating the measuring model measurement by testing the scales of reliability analysis and validity analysis. Structural model was evaluated by Bootstrapping (N = 5000).

3.4. Measurement

Almost all constructs in this study used scales from previous high-ranked journals. These above constructs were adopted from previous scales in the high-ranked journal written in English with adjustments and adaptations suitable for the context. The scale of customer immersive experience was measured through three items on the scale by Yim et al. () formed by three items. Regarding the outcomes of the research model, customer responses were assessed by attitude toward MAR apps and adoption intention regarding the MAR apps measured (Rese et al., 2017). Respondents were asked to evaluate different attitudes and behaviors of others, all of which were based on sample frames selected intentionally. Additionally, these customer response variables were measured by adapting five-item scales of each. In addition to a moderating construct, the framework posits that individual differences (e.g. technology anxiety) have moderating effects between customer immersive experience and its outcomes. Technology anxiety was measured by Venkatesh et al. (2014) consisting of four items (e.g. “I feel apprehensive about using MAR apps”).

Because the scales in the current study were adopted from previous studies, it was necessary to use control variables to reduce systematic errors in data collection and analysis. Three control variables used in this study, including privacy concern, education and gender are used to reduce systematic errors in data collection and data analysis. These control variables were evaluated to test their effects on adoption intention (e.g. Rauschnabel and Ro (2017), Moore and McElroy (2012), and Venkatesh et al. (2014). A questionnaire was initially adopted in English and then translated back into Vietnamese. Vietnamese-English translation needed to be consistent in content in the questionnaire to avoid data bias. All items of construct scales were measured on 7-point Likert scale (from 1 = entirely disagree to 7 = completely agree).

4. Results

4.1. The results of descriptive analysis

In the data set of samples, the majority of respondents were female (59%) and urban (56%), age level between 25 and 55 (87%). Most of respondents were at undergraduate degree level or below

Table 1. Characteristics of respondents

Characteristic	Item	Frequency (n = 332)	Percentage (%)
Gender	Female	196	59
	Male	136	41
Frequency of Mobile apps experience	Daily	40	12
	Some times a week	34	10
	Once a month	131	39
	Some times a month	83	25
	Some times a year	44	13
Age (years old)	15 ≤ Age < 25	27	8
	25 ≤ Age < 35	98	30
	35 ≤ Age < 45	119	36
	45 ≤ Age < 55	73	22
	Age ≥ 55	15	5
Area	Urban	187	56
	Rural	145	44
	Secondary school	4	1
	High school	11	3
	Intermediate	37	11
Education	College	105	32
	Bachelor	132	40
	Postgraduate	25	8
Monthly Income (million VND)*	Others	18	5
	Income < 5	9	3
	5 ≤ Income < 10	36	31
	10 ≤ Income < 15	127	28
	15 ≤ Income < 20	131	29
	Income ≥ 20	29	9
Total		332	100

* VND: Vietnam dong(Source: Author's calculation)

(87%), and almost all respondents were using mobile apps in their experience. In terms of income per month, 3% respondents had an income less than five million VND, 28% respondents from 10 to 15 million VND per month, 29% respondents had an income from 15 to 20 million VND. The most impressive percentage is 31% of customers' monthly income from 5 to 10 million and the rest made more than 10 million VND. The characteristics of chosen respondents are showed in Table 1.

4.2. Validation of measurement model

According to Hair Jr et al. (2016), partial least squares – with structural equation modeling (PLS-SEM) software was recently utilized in retailing settings, particularly augmented reality applications (Nikhashemi et al., 2021), thus using PLS-SEM is suitable for our study. Moreover, the Partial Least Square (PLS) to analyze the collection data because of some reasons like PLS-SEM's small sample size capabilities, using the HTMT criterion for discriminant validity testing, not necessarily assessing a PLS path model's goodness-of-fit, etc. (Hair et al., 2019).

In order to evaluate the scales' reliability in the measurement model, previous studies of (Hair Jr et al., 2016; Hair Jr et al., 2017) in related to PLS-SEM showed that Cronbach's alpha (CA), composite reliability (CR), average variance extracted (AVE) and factor loadings were used to test

Table 2. Accuracy analysis of constructs and indicators

Constructs/dimensions	Factor loading	CA	CR	AVE
Immersive experience While I was using this augmented reality service,		0.900	0.938	0.834
I was absorbed in what I was doing	0.889			
I was immersed in the task that I was performing	0.938			
I felt completely immersed	0.911			
Attitude toward the AR apps		0.907	0.931	0.731
I am positive about the AR app.	0.842			
The AR app is so interesting that you just want to learn more about it.	0.906			
It just makes sense to use the AR app.	0.907			
The use of the AR app is a good idea.	0.857			
Other people should also use the AR app	0.756			
Adoption intention regarding the AR apps		0.906	0.930	0.727
If I were to buy this product in the future, I would ...				
... download or use the AR app immediately.	0.818			
... give the AR app priority over the printed catalogue.	0.887			
... I recommend using the AR app to my friends.	0.905			
... use the AR app regularly in the future.	0.878			
... give the AR app priority over the catalogues of other providers.	0.798			
Technology anxiety		0.933	0.952	0.832
I feel apprehensive about using AR apps.	0.883			
It scares me to think that I could lose a lot of information using AR apps by hitting the wrong key.	0.905			
I hesitate to use AR apps for fear of making mistakes I cannot correct.	0.900			
I have avoided technology because it is unfamiliar to me	0.959			

Note. AVE = average variance extracted; CA: Cronbach Alpha, CR = composite reliability;

Table 3. Table Fornell-Larcker criterion and Heterotrait-Monotrait ratio (*)

	1	2	3
1. Attitudinal response toward AR apps	0.855		
2. Adoption intention regarding the AR apps	0.481/0.523*	0.853	
3. Immersive experience	0.72/0.630*	0.387/0.424*	0.913

indicators' reliability. The results (see, Table 2) revealed that all Cronbach's alpha value and composite reliabilities were superior to the recommended value of 0.7, showing that the constructs' reliability was significant in measurement model. The average variance extracted (AVE) and value of factor loadings is used to test the constructs' convergence validity. The results (see, Table 2) showed that all factor loadings were greater than 0.7 and AVE values were higher than 0.5. Thus, the constructs' convergence validity has a satisfactory results (Hair Jr et al. (2016).

4.3. The discriminant validity

According to (Hair Jr et al. (2017)), the aim of this study is to evaluate the discriminant validity three valid PLS-SEM criteria were followed: (i) the loading coefficients must be greater than the cross loads; (ii) the inter-construct correlations must be less than the square root of the AVE values; and (iii) HTMT values of the latent variables were lower than 0.85 (Hair Jr et al., 2016) and the heterotrait-monotrait (HTMT) ratio must be less than 0.9. Therefore, the measurement model was validated by the above results (see, Table 3).

4.4. Testing the structural model and its relationships

According to Hair Jr et al. (2017) and the results in this study, all collinearity Statistics (VIF) values is less than 5.0., thus collinearity phenomenon among predictor variables did not occurs. Moreover, the SRMR value in this study is 0.049, which is less than 0.08. Therefore, the model has a good fit and can evaluate the structural model measurement. The structural model was analyzed through R^2 value and the value of the significance of relations in research model (P-value) using bootstrapping with 5,000 samples. The structural model was tested and the results are displayed in Table 4, R^2 value is used to measure the fit of the model and the predicting power of the structural model Hair Jr et al. (2017). According to Henseler et al. (2010), effect size (f^2) refers to "the increase in R^2 relative to the proportion of variance of the endogenous latent variable that remains unexplained." Effect size (f^2) values of 0.02, 0.15, and 0.35 showed that small, medium, and large effects, respectively (Henseler et al., 2009). As can be seen in Table 4 and figure 1, all the model hypotheses were supported.

4.5. Testing the hypotheses in the proposed model

5. The quality of the proposed model

The value of SRMR was 0.049, which is less than 0.08, asserting a good fit to test the hypotheses in the model. Moreover, Stone-Geisser Indicator (Q^2) and R-squared (R^2) values of the endogenous constructs were used to assess the predictive relevance and predictive power of the proposed research model. As described in Figure 1, the results of R^2 of immersive experience (0.631), attitude toward MAR apps (0.508), adoption intention regarding MAR apps (0.346) all obtained the substantial level (Henseler et al., 2009), thus indicating the endogenous construct's predictive power in the current model. Moreover, according to variables, the Q^2 result of immersive experience was higher than zero, thus proving the predictive relevance of other latent. In addition, after calculating t-test from 5000 samples of bootstrapping analysis, Cohen's Indicator in Table 5 were used to evaluate the effect size (f^2) of construct's relationships (Henseler et al., 2009) with the values range from 0.18 to 0.36, proving that the robustness of the relationships of latent variables had medium and strong effect sizes level (Hair Jr et al., 2017). In general, these above analysis reveal that there

Table 4. Hypothesis testing results

Paths (hypotheses)	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O/STDEV)	P values	Results
Mediating effects						
Immersive experience -> Attitudinal response toward AR apps (H1)	0.572	0.572	0.048	4.840	0.000 ^a	Significant
Attitudinal response toward AR apps -> Adoption intention (H2)	0.258	0.264	0.076	3.385	0.001 ^b	Significant
Direct effects						
Immersive experience -> Adoption intention (H3)	0.147	0.150	0.059	2.482	0.013 ^b	Significant
Moderating effects						
Moderating 1 (H4a)	0.126	0.132	0.049	2.591	0.01 ^b	Significant
Moderating 2 (H4b)	0.019	0.015	0.052	2.358	0.013 ^d	Significant
Control variables						
Age -> Adoption intention regarding the app	0.086	0.086	0.045	1.903	0.06 ^c	Significant
Education -> Adoption intention regarding the app	0.111	0.111	0.048	2.306	0.021 ^d	Significant
Income -> Adoption intention regarding the app	0.156	0.155	0.051	3.078	0.002 ^b	Significant
Privacy concern -> Adoption intention regarding the app	0.198	0.199	0.074	2.666	0.008 ^b	Significant

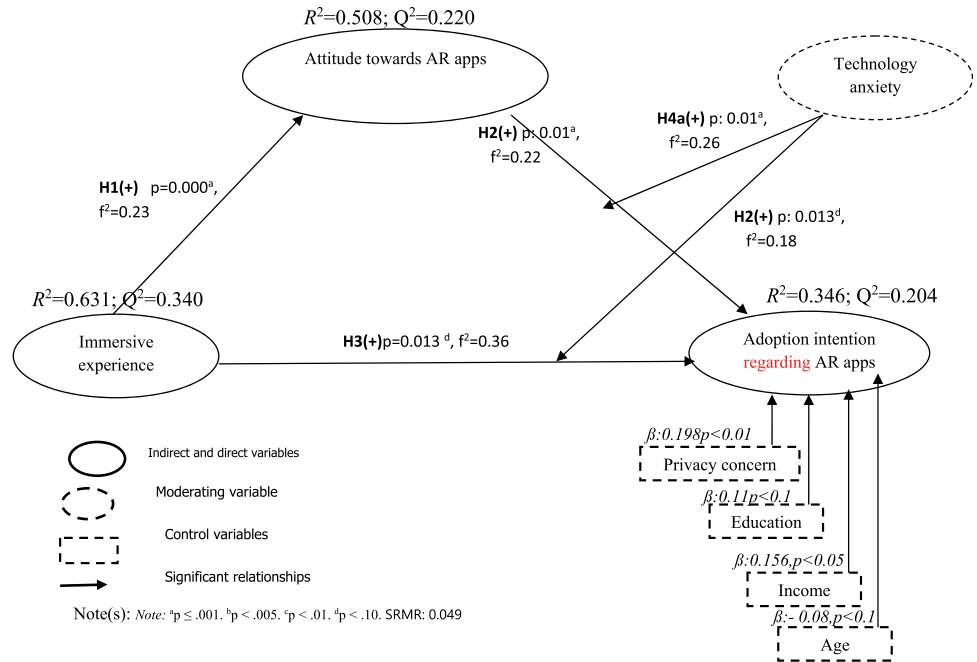
Note: ^ap ≤ 0.001. ^bp < 0.005. ^cp < 0.01. ^dp < 0.10. N = 332, Bootstrap sample size 5,000. R² Immersive experience: 63.4% Q²: 0.475

was a qualified structural model. In the next step, direct relationships, mediating, and moderating effects will be described and analyzed below.

Direct and mediating effects:

According to Zhao et al. (2010), using bootstrapping test (5,000 samples) in PLS-SEM software can examine the moderating, mediating effects instead of replace the Baron-Kenny's procedure as well as the Sobel's test. The results in **Table 5** pointed out that most of the hypotheses among latent variables were statistically significant. In detail, indirect effects of H1 ($\beta = 0.572$, $t = 4.840$, $p < 0.001$), H2 ($\beta = 0.258$, $t = 3.385$, $p < 0.005$) had a significant impact in their indirect relationships in research model. **Table 5** shows how mediating variable impacts, consisting of hypotheses H3 ($\beta = 0.147$, $t = 2.482$, $p < 0.05$) were supported at 99%, 95% confidence level, respectively, thus H3 were supported. These analyses is essential for testing the control variables of privacy concern, education, income and gender on adoption intention regarding MAR apps. The f^2 values of attitude

Figure 1. Research framework and hypothesis-testing results.



toward MAR apps on adoption intention regarding MAR apps at 0.36, pointing out that the strength of the relationships had strong effect sizes.

Moderating effects:

The purpose of the present study is to examine the moderation (the interaction effect) (moderation) of technology anxiety on the interrelationships adoption intention and its antecedents. SmartPLS software was used in this study to test the interaction (Hair et al., 2016). In detail, hypothesis H4a was supported ($\beta = 0.126$, $t = 2.591$, $p < 0.001$), indicating that technology anxiety moderated the effect of attitude toward MAR apps and adoption intention. On other hand, hypothesis H4b, which proposed that technology anxiety moderated the effect of immersive experience and adoption intention, was also acceptable ($\beta = 0.126$, $t = 2.591$, $p > 0.01$). The strength of the interaction effects of two moderating relationship H4a ($f^2 = 0.26$) and H4b ($f^2 = 0.18$) were revealed with medium effect sizes. Therefore, the results of this study pointed that technology anxiety strengthened the relationship between immersive experience and its antecedents.

6. The effect of control variables

Control variable analysis to test their effects on adoption intention regarding MAR apps. Among the four control variables, privacy concern, income, and education level had significant effects on adoption intention regarding MAR apps as the dependent variable. Specifically, privacy concern had a positive effect on adoption intention regarding MAR apps ($\beta = 0.198$, $t = 2.66$, $p < 0.01$). Similarly, other control variables as education level ($\beta = 0.11$, $t = 2.306$, $p < 0.1$) and income monthly ($\beta = 0.156$, $t = 3.078$, $p < 0.1$) had a positive effect on this dependent variable. The impact of age level on adoption intention regarding MAR apps was acceptable ($\beta = 0.086$, $t = 1.903$, $p < 0.1$). The results are revealed in **Table 5**, proving control variables, including privacy concern, education, age, and income monthly, were significant.

7. Discussions and implications

Our study aims at developing and empirically testing the dynamic model connecting customer immersive experience, attitude and adoption intention toward MAR apps under the contingency role of technology anxiety. Based on the data from 322 online shopping participants, the testing results demonstrate that all proposed hypotheses are supported. The finding that immersive experience has significant and positive effects on customers' attitude and adoption intention toward MAR apps helps confirm our argument regarding the enormous potential of interactive technologies like MAR apps in providing added value to customers and resulting in profitability to online retailers. While previous studies (Kowalczyk et al., 2021; Song et al., 2018) focus on students using MAR apps at campus of universities where it is easy for them to download, install, and virtual try-on, in our study, customers with different ages and education levels are investigated to identify their responses after trying MAR apps. In addition, consistent with a number of prior studies (e.g. Song et al., 2018; Yim et al.), our finding supports that MAR apps enable customers and potential users by touching them through camera on smartphone, then customers are confident to make purchase decisions. MAR apps help customers see how many products can fit them personally (Rese et al., 2017). When customers interact with the objects, they feel immersed in MAR apps, their adoption intention toward MAR apps increases. AR-based apps shape customer behaviors through introducing digital information into customers' perceptions (Hinsch et al., 2020). Moreover, MAR apps obviously support retailers to establish long-lasting relationships with their customers, so this technology has the potential to change the way customers socialize, interact, and conduct their business. MAR apps give retailers profitable benefits in stimulating customers to virtual try-on, increase their brand awareness and customer loyalty. In particular, AR technology enables retailers to redesign and reshape mobile apps-based retail stores by promoting customers' immersive experience. Retailers can apply MAR apps to provide customers with virtual try-on experience to identify which are the best products suitable for their requirements. Thus, MAR apps are important tools for retailers to generate a memorable experience and make customers become more immersed and engaged.

Our study also examines the moderating role of technology anxiety on the relationships between adoption intention using MAR apps and its antecedents in the model. The results reveal that customers with high level of technology anxiety tend to perceive that the benefits of emerging technologies like MAR apps are more considerable, and they are more willing to spend time using MAR apps and frequently use these virtual try-on apps when shopping online. Our moderating finding provides additional evidence to advocate that technology anxiety as customer traits plays a crucial role in moderating the relationships between their immersive experience and its outcomes. Kim and Forsythe (2008a) also study technology anxiety as moderator variable on the relationship between attitude and intended usage of virtual try-on apps, however their finding indicates insignificant impact on the virtual try-on process via online virtual experience. Our finding contributes to the existing knowledge regarding the moderating role of technology anxiety when consumers experience MAR apps in retail settings, especially in the developing market of Vietnam.

8. Theoretical implications

Our study contributes to the literature pertaining to customers' adoption intention toward MAR apps in several ways. First of all, previous empirical studies have focused on some psychological states such as customer engagement (e.g. (Ho et al., 2021; Jessen et al., 2015), presence (e.g. (Orús et al., 2022; Wang et al., 2021), and flow (Arghashi & Yuksel, 2022; Barhorst et al., 2021). In this study, customer immersive experience is also considered as one of the psychological states possessing direct and indirect positive relationships with the adoption intention using MAR apps in the context of a Vietnamese developing market. In addition, the adoption intention of MAR apps can be considered as an antecedent of purchase decision or consumer behavior as the Theory of Planned Behavior (Ajzen, 1991). The use of MAR apps enables customer immersive experience that lead to positive attitude and adoption intention which, in turn, facilitate purchase decisions.

Regarding the usage of interactive technologies, individual traits ready for adopting new technologies as personal innovativeness, sensation seeking tendency (Huang & Liu, 2019; Jung et al., 2015; Suh & Prophet,) have been advocated to moderate customer evaluation, feelings on adoption responses. Our moderating finding demonstrates technology anxiety, also as one of individual traits pertaining to the apprehension of new technologies, has a crucial impact on the relationships from immersive experience to attitude and adoption intention toward MAR apps.

9. Managerial implications

Drawing on the above findings that clarify how MAR apps can be an interactive technology for markets related to immersive experience, attitude, adoption intention, and technology anxiety, this study provides the following managerial implications for retailers.

First of all, future MAR apps are expected to be applied for getting more information about products (e.g., make-up, shoes, glasses, clothing, etc.) and for online shopping anywhere, anytime via smartphones, and for enhancing consumer immersive experience. MAR apps based virtual stores will affect the way in which retailers pay attention to their consumers. Due to virtual try-on through smartphones, customers feel more engaged in these augmented reality activities that influence their positive evaluation related to product choices. With MAR apps, customers can virtually try on products on their smartphone without having to visit physical stores. According to Oyman et al. (2022), AR market is estimated to be \$50 billion before 2024, 71% of consumers shopped more frequently from retailers using AR and they would be willing to pay more for the products offered via AR. Thus, retailers should provide products through MAR apps to create immersive experience for their customers.

Moreover, this research uncovers that after virtual try-on MAR apps, customers' immersive experience leads to positive attitudes, then they are more willing to use MAR apps again in future purchases. The finding also shows that the positive attitude reinforces their adoption intention. Managers should keep in mind that if customers have positive ideas about MAR apps, in the future, when they intend to buy products, they will use these technologies in their purchase process, and might even recommend others to use them.

Last but not least, the moderating effect of technology anxiety on adoption intention suggests that firms pay attention to customer's technology anxiety. Daassi and Debbabi (2021) argue that young people tend to have less technology anxiety about virtual try-on apps than older people. The results show that customers are more interested in interactive technology as MAR apps. Recently, new technologies are increasingly applied in the retailing sector, individual traits such as technology anxiety should get more attention because it is closely related to avoidance behaviors. The increasing appearance of fraud on smartphones and mobile applications makes customers more anxious about providing personal information. Thus, online business firms should be concern about users' technology anxiety and provide easy-to-use MAR apps and ensure their secured personal information.

10. Limitations and future research

This study aimed to explain the moderated mediating effects on customer immersive experience using MAR apps; however, there are some limitations. Firstly, the data of this study was only collected in Ho Chi Minh city, which are presented for urban and rural area of Vietnam, respectively. Future studies could extend the data collection (e.g. other developing countries in same Asian region) to reach a more general results. Secondly, this study can narrow the target samples as student. Because most of students use their smartphones applications and integrate them into their daily lives, they tend to feel more immersed in and more readily adopt new technologies than others (i.e. older consumers). Thus, students have become significant targets as potential consumers of new MAR apps, serving as candidate population for future research. Moreover, most respondents focused on some MAR apps, more MAR apps-related functional features can be applied for future research. This study only evaluated adoption intention regarding MAR apps as

a dependent variable, future research can add variables that derive from adoption intention regarding MAR apps, such as actual purchase behavior or decision comfort.

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