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ORIGINAL CONTRIBUTION

The Mediating Role of Interactivity between Perceived Usefulness, Perceived Enjoyment and Intention to Use Augmented Reality Application for Shopping

Najjia Ejaz Chaudhry [1], Waseem Subhani [2*], Muhammad Azeem Naz[3], Muhammad Umair Nazir [4], Muhammad Huzaifa Ameer [5]

[1,2]Institute of Business Administration, University of the Punjab, Lahore, Pakistan

[3] School of Commerce and Accountancy University of Management and Technology, Lahore, Pakistan

[4]Minhaj University Lahore, Lahore, Pakistan

[5]Ameer-ud-din Medical College, Lahore General Hospital, Lahore, Pakistan

Abstract— Augmented Reality (AR) is a technology that adds digital data created in real-time by a computer to the physical world. Offering (virtual) items opens new and fascinating ways for customers to engage with the brand and its merchandise. While the augmented Reality (AR) technology market is forecasted to experience exponential growth by 2030, numerous businesses have already endeavoured to leverage the technology to extend their operations. However, prior literature still needs to document the empirical evidence of whether AR technology adoption will positively impact or improve consumers' shopping habits based on AR technology. The study assesses the gap statistically; this work uses a survey method to determine the causal influence of many augmented reality applications on university students. A suitable sample of executive students has been chosen to investigate influences on behavioural intentions through experiments. In conclusion, the perceived usefulness and enjoyment of AR will be notably high, with a retail focus that will influence users' behavioural intentions and encourage them to make purchases through AR apps. Interactivity was highly significant, mediating the influential effect of enjoyment, perceived usefulness, and behavioural intention to use AR shopping apps and, thus, determined to be a key driver.

Index Terms— Augmented reality, Virtual technology, AR apps, Perceived usefulness, Enjoyment, interactivity, Behavioural intention, Consumer behaviour, TAM, ICT

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Introduction

In the evolving technology world, Augmented Reality (AR) has become quite popular lately. Through AR apps, users can seamlessly integrate digital information into the environment (Oyman et al., 2022). Kim et al. (2023) detailed a hybrid experience that combines context-sensitive virtual data with physical reality; AR mobile marketing is used to increase client engagement. AR is a real-time, three-dimensional (3D) model that enhances the image of the physical world on smartphone screens; according to Kumar et al. (2023), Augmented reality has come a long way since Ivan Sutherland's groundbreaking head-mounted prototype in 1960 (Barta et al., 2023; Sung et al., 2022). The AR facilitate the users based on the 3D orientation based on sound and images to experience their environment (Saleem et

*Email: waseemsubhani@yahoo.com

al., 2022). AR finds utility across diverse industries, including marketing, healthcare, education, gaming, automotive, and aviation, transforming these sectors by reshaping existing products and services (Hinsch et al., 2020). In the early 1900s, Boeing scientists developed AR technology, which is currently widely used in various aspects of life (Liu et al., 2022). AR significance has grown owing to multiple factors, including the Global Positioning System (GPS), advancements in technology, decreased costs, widespread internet accessibility, and improved portability (Rauschnabel et al., 2019). Since the last decade, the trends and popularity of AR have grown by over 400%. Big names in the industry have branched out into augmented reality solutions, including Google, Amazon, Microsoft, Snapchat, Facebook, IKEA, Adidas, and Apple (Baytar et al., 2020; Sudharshan, 2020).

There is a lack of consensus in the empirical study that has been done on consumers' impressions of augmented reality apps as a means of generating prominent media coverage. Qin et al. (2021), Sung et al. (2022), and Watson et al. (2020) show, for instance, that researchers are keenly interested in figuring out how various media attributes—vividness, augmentation, telepresence, technostress, and novelty—culminate in desired outcomes, such as positive brand attitudes, purchase intentions, consumer engagement, impulse buying, and usage intention. Furthermore, some research suggests that characteristics of AR influence users' attitudes and intents when using AR apps (Hsu et al., 2021). But there have been difficulties along the way. Scholars can't seem to agree on what constitutes interactivity as a mediator among AR app users (Jung et al., 2021; Roxo & Brito, 2020). Given the TAM model, it is essential to have a thorough grasp of the media characteristics that cause stress and how they interact to influence customer behaviour intentions (Tiwari et al., 2023). Given the diverse empirical findings and the increasing interest of practitioners in AR shopping applications, these insights serve a variety of stakeholders, including academics, practitioners, and theorists(Khalil & Khan, 2019). The practical consequence is that practitioners can choose engagement, positioning, advertising, and targeting techniques with more knowledge (Nhan et al., 2022). To this end, we have conducted a quantitative study of empirical research on augmented reality apps in retail, concentrating on the relationship between media attributes, user interaction, and the intention of consumers to behave (Tiwari et al., 2023).

Due to the COVID-19 pandemic and other technical changes, the long-standing commercialization of augmented reality has significantly changed how individuals complete activities. Despite this, customers have continued to purchase online more than before the epidemic (Saleem et al., 2021). García-Pereira et al. (2020) state that industry analysts anticipate a significant increase in the use of AR technology in the USA over the next five to ten years, with the healthcare sector holding the greatest expectations. Furthermore, the findings show a significant increase in the use of AR in the Architecture, Engineering, and Construction (AEC) industry from 2017 to 2019 (Yoo, 2023). The potential benefits of Augmented Reality (AR) for Nigeria's criminal justice system were examined (Jaishankar, 2020). The article argues that Nigeria's judiciary must integrate Augmented Reality (AR) technology into its criminal justice system, citing secondary sources and The Malthusian Theory of Population as its foundation. According to a study conducted in Germany by (Altmeyer et al., 2020), Augmented Reality (AR) appears to be the best technology for presenting information during testing because it can integrate both real-world and virtual lab activities. The AR-enabled one was the only lab activity where gains in conceptual understanding through cognitive load learning were evident(Khan, Hussain et al., 2019). According to Armelia Windasari et al. (2022), telepresence on augmented reality and product information could positively affect customers' buying decisions in Indonesia. Remarkably, there was no appreciable difference in the purchases made through brick-and-mortar stores versus traditional websites, two alternative channels of purchase that indicate female customers are more likely to focus on the products they want to buy rather than the technology and method of purchase(Khan, Yaseen, et al., 2019). The visualization of the information revolution was examined by Noghabaei et al. (2020); they emphasized the suitability of immersive 3D techniques such as Augmented Reality (AR) for these purposes, unlike 2D information. The most efficient way to visualize summarised data about the state and management of a smart city, like Dubai's smart city system, is through spatial augmented reality (SAR). The United States, Greece, Taiwan, China, Spain, Portugal, and Malaysia were the countries that looked at integrating augmented reality and gamification into education the most, according to data from (Lampropoulos et al., 2022). Most studies that looked at STEAM-related subjects and problems that students face daily focused on higher education as the educational level (Saprikis et al., 2021).

Although Pakistan's consumer base is continually growing, marketers are not fully utilizing the potential of technology to raise awareness of their products. Over the period of time, it is predicted that mobile communication become vital to manage operations (Islam & Mazumder, 2010). This generation has a vast service area and the ability to serve a large number of users, the most well-known generation of mobile phones.

Pakistan has seen a notable increase in the digitalization of its economy, which has increased marketers' concerns about conducting effective CRM. Pakistan is home to over 500 cell towers and IT companies, and these figures will only continue to rise (Javed, 2020). Shopping retailers in Pakistan are new to using technology; they formerly bought and sold via conventional brick-and-mortar methods (Saleem et al., 2022). The widespread COVID-19 pandemic is another factor contributing to this technological transition(Khan et al., 2022). It has forced everyone to rely on cell phones for everything from banking payments to grocery and clothing buying, even booking taxis and doing laundry at home (Faqih, 2022). Furthermore, as the pandemic progressed, the data utilized to assist decision-making also altered, and the data's purpose and importance for pandemic management also varied over time. Thus, in this post-pandemic period in Pakistan, it is imperative to understand the kinds of services, products, and information available at different points of touch (Saleem et al., 2021).

According to DAWN's recent survey, Pakistan has the fastest-growing app market globally as of 2022 (Dawn, 2023). With growth rates of 35.4% in 2017 and 26.8% in 2021, China ranked second on the list, but the growth rate was almost three times higher. India, Mexico, and Indonesia were the following three nations with growth rates of less than 10% (figure 1). With 3.5 billion downloads, Pakistan outperformed all comparable markets except Indonesia. Southeast Asian countries have the most significant number of publishers and natively developed apps, which supports the trend, according to supplementary statistics. Pakistan ranked sixth globally in 2022, with 161 billion hours spent on mobile applications by its citizens (Dawn, 2023).

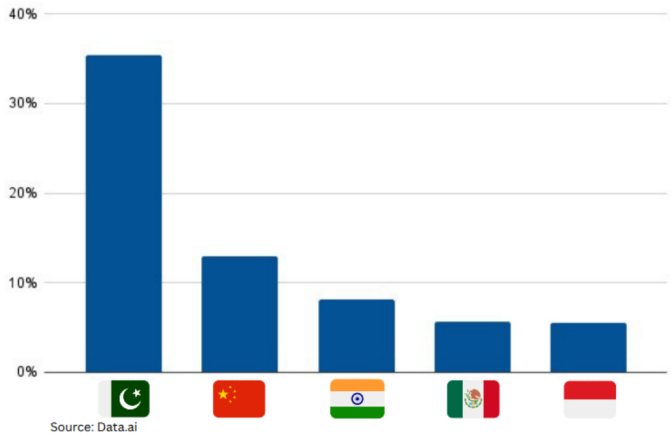

Fig. 1 *Country-wise rate of Application download (Dawn, 2023)*

By examining the factors that influence customers' behavioural intentions to use augmented reality shopping apps, the current study aims to further the literature. However, no such research has been conducted in Pakistan or Asia (Saleem et al., 2022). Conversely, most related literature studies on adopting AR technology and applications have focused on industrialized nations (Saleem et al., 2021). However, in developing countries, not much research has been conducted. As mentioned, little research has been done on Pakistan's adoption of augmented reality (AR) technology and applications (Egaji et al., 2022). In this part of the world, not much research has been done on the subject, especially when analyzing the adoption of mobile augmented-reality shopping apps (Faqih, 2022).

Thus, this study aims to understand better and explore the factors driving the adoption of mobile augmented reality apps in Pakistan. This type of study thereby closes a research gap in the body of current literature. Overall, the present study broadens our perspective and acknowledges our limits while contributing to our understanding of this emerging field of inquiry, particularly as it relates to less technological country contexts (Baabdullah et al., 2022; Kazmi et al., 2021; Wang et al., 2022). Given the recent acceleration of research on augmented reality in commerce, this study is very pertinent. The sample selection, research methods, and analytical strategies are covered in detail in the following sections.

Theoretical Review and Hypothesis Development

Augmented Reality (AR)

Augmented reality (AR) is a technology in which virtual objects are immersed in the natural environment using augmented reality technology via a mobile application (Barta et al., 2023). Augmented reality permits the addition of another layer of the virtual world to the physical world (Furquan Saleem et al., 2022; Nhan et al., 2022). Using a computer or smartphone camera allows users to explore their surroundings with virtual objects projected on them (Egaji et al., 2022; Fan et al., 2020). Many businesses, however, lack the expertise and capacity to enhance interactive customer experiences that may reach and fully engage their customers (Sung et al., 2022). It is necessary to understand how AR marketing differs from other marketing techniques in that it creates and provides immersive experiences for customers (Chaudhry et al., 2023). The extensive methodology offered in this paper will give readers a deeper understanding of user experiences, attitudes, and behaviours in AR contexts (Shin & Jeong, 2021; Smink et al., 2020). Numerous AR characteristics are described in the existing literature, including interactivity, perceived usefulness, enjoyment, novelty, vividness, augmentation, contextual embedding, spatiality, and physical control (Barta et al., 2023; Kumar et al., 2023; Yoo, 2023). Perceived usefulness and enjoyment are two crucial characteristics of AR applications that predict consumers' behavioural intention to use AR apps (Park & Yoo, 2020; Kim et al., 2023).

Technology Acceptance Model (TAM)

The TAM model claims that rejection and acceptance of technology or usage of computers (Davis et al., 1989). Therefore, the goal of TAM development is to pinpoint the elements crucial to adopting new technology (Tiwari et al., 2023). The TAM theoretical framework has faced criticism because of its simplistic interpretation of technology adoption. In order to incorporate variables on human behaviour and experience, TAM2 and TAM3 were introduced; later, UTAUT and UTAUT2 (Venkatesh et al., 2012; Subhani et al., 2023) followed. The model in this study seeks to identify the internal (PE) and external (PU) elements influencing users' behavioural intentions (Oyman et al., 2022).

Even though the model was first presented in the literature a long time ago, there is still a lot of interest in using it in research. For example, this model is used in consumer studies on how people use mobile applications (Huang & Ren, 2020) and modern technologies like Google Home and Amazon Alexa (Canziani & MacSween, 2021). Thus, it makes sense to use a simple, understandable, and organized technology-related model and expand it with context-specific AR elements that affect consumers' behavioural intention to use AR app technology. As a result, the context-specific augmented reality features are covered in the next section.

Perceived Usefulness (PU)

The perceived usefulness is one of the main factors impacting the uptake of new technologies. Davis et al. (1989) provided the initial definition of perceived usefulness; he said PU is the theory that using computer technology would improve a person's professional performance (at work). Regarding mobile applications, perceived usefulness denotes the benefits the user will experience upon using the application (Sung et al., 2022). According to (Arghashi and Yuksel, 2022), the inclination to employ virtual garment testing technology was positively influenced by perceived usefulness. According to (Davis et al. (1989, p. 982), who conducted the study that formed the groundwork for the TAM, consumers' intentions to use new technologies were most influenced by their perceived usefulness. Perceived usefulness of augmented reality apps rises when it provides prospective details on the salient characteristics of the product, including variety, quality, size, colour, price, and suitable fit (Windasari et al., 2022; Fan et al., 2020; Wang et al., 2022).

According to Huang & Ren (2020), augmented reality applications have been recognized for their ability to inform and inspire users to use smart devices to showcase tangible products visually. Complete information is provided by the use of new technology, which has made the significant reactions feasible. With augmented reality apps, customers can try on several kinds of glasses without physically visiting stores (Zimmermann et al., 2022).

Thus, augmented reality applications allow users to try on items and navigate around a real-world setting digitally, assisting buyers in gathering sensory data regarding a product's quality (Baytar et al., 2020; Richter et al., 2017; Tang et al., 2019). Customers can look up more details about a product, like colour, size, and texture, using augmented reality apps, which show a close-up of the item (Daassi & Debbabi, 2021; Ballantine et al., 2010). Retailers can also benefit from augmented reality apps because they give consumers the necessary information and timely updates about online products, which provides them with more confidence to shop and, ultimately, increases their willingness to purchase (Liu et al., 2022; Nhan et al., 2022; Poushneh & Vasquez-Parraga, 2017). In the light of the above discussion, the following hypothesis is made.

H1: There is a significant association between perceived usefulness and intention to use AR technology.

In order to understand usage behaviour, J. M. Lee et al. (2019) offered empirical evidence in favour of interactivity (INT), a necessary component for expanding the basic TAM model. Three factors were used (McLean & Wilson, 2019) to measure interactivity: Time, user control, and communication direction. With an emphasis on two-way communication, the direction of communication is concentrated on how AR apps support human connection (Feng & Xie, 2019). While some research focuses on app design and human perception, user control analyses how people interact with mobile apps (Yim et al., 2017; Rauschnabel et al., 2019). Time is the third interactive component that assesses how quickly and simply a user can go through the application (Akdim et al., 2022). The advantages of working on their schedule and selecting their shopping timings are offered to users of interactive systems (Fajriyah et al., 2023). According to the present study, PU leads to consumers' favourable perceptions of the interactivity of AR shopping apps, affecting their behavioural intent to use the apps. We improved the TAM model by using interactivity as a mediating variable. As a result, the following hypotheses are made:

H2: There is a significant association between perceived usefulness and interactivity.

Perceived Enjoyment (PE)

The significance of Perceived Enjoyment concerning technological attributes has been studied. Perceived enjoyment is "the activity of using a specific system that is enjoyable in its own right, aside from any performance consequences resulting from system use" (Venkatesh et al., 2012). According to the literature, a person's level of enjoyment can affect how they use mobile app technology (Holdack et al., 2022), the Internet (Venkatesh et al., 2012), and computers (Davis et al., 1989). According to Akdim et al. (2022), users should anticipate a fun and engaging experience from AR apps. As a result, one of the key factors in determining how new technology is adopted and used is perceived enjoyment.

The fact that augmented reality apps are still easily accessible on smart devices and provide authentic shopping experiences with rich content visualization is one of their advantages (Lampropoulos et al., 2022; Rese et al., 2017). Through augmented reality apps, consumers are delighted to interact with virtual products (Kim & Park, 2019; Lee et al., 2010; McLean & Wilson, 2019). According to (Kim et al., 2023), according to the updated Journal of Internet Commerce Seven, augmented reality apps can benefit consumers' attitudes about utilizing them. Users would find it easier to shop online if augmented reality apps included rich contexts with crisp visuals, colour, scale, motion, humour, and other interactive elements(Asif et al., 2021).

A recent study revealed users' opinions of the impact of enjoyment on AR gaming apps (Saprikis et al., 2021). A study investigated the main psychological elements that motivate people to play AR mobile games like Pokemon Go. Enjoyment was the primary element influencing the uptake of AR games on mobile devices (Faqih, 2022). According to research by (Holdack et al., 2022), customers' attitudes toward using augmented reality apps are positively impacted by their perceived enjoyment. (Wang et al., 2023) This study put out the following hypothesis about the above arguments.

H3: There is a significant association between perceived enjoyment and intention to use AR.

The immersive nature of Augmented Reality (AR) has the potential to provide consumers with a hedonistic experience that is both highly exciting and delightful (Rauschnabel, 2021). It was discovered that the enjoyment that AR produces momentously influences behavioural intentions. For example, Yim et al. (2017) found that users' behavioural intention results from the high interactivity features of AR apps produced by enjoyment. In addition, those who watch computer-generated imagery in high-quality reports feel more satisfied than those who care about low-definition computer-generated imagery.

According to Hinsch et al. (2020), 3D users, for instance, have relatively higher levels of enjoyment than 2D users, increasing their interaction level. By seeking out high-quality information and reducing the risk brought on by information asymmetry, consumers equipped with AR app technologies might interact with the app through utilitarian and hedonistic values (Zhang et al., 2022). Bui (2023) states that user contact with AR applications increases customer engagement and fosters happiness. Thus, from a hedonistic standpoint, enjoyment enhances user interactivity and caters to specific demands (Kowalczuk et al., 2021; Nhan et al., 2022). In light of the above discussion, we propose the following hypothesis.

H4: There is a significant association between enjoyment and interactivity.

Interactivity (INT)

According to Chekembayeva et al. (2023), speed, interactivity, and the degree to which extent of user manipulation or modification of technology in real-time, leads to increased customer involvement. According to Kumar et al. (2023), interactivity is a technological system's capacity to make it simpler for users to interact and become involved with the topic or material. According to Kim et al. (2023), interactivity refers to 3D representation along with how much a user may move, zoom, and rotate the product images using augmented reality. This feature promotes user involvement with the products. According to Kim et al. (2023), interaction is essential for augmented reality apps. However, it can take many various forms. For instance, providing consumers with various customization options will enhance the interactivity of AR and positively influence users' perceptions of the technology. AR apps with interactive features encourage positive user experiences (Qin et al., 2021). Customers who actively participate in and manage the virtual environment and its modules in real time enjoy an enriched experience through their engagement (Zhao et al., 2020). As per Somthawinpongsai et al. (2021), interactivity represents a stimulus-driven factor that encompasses the capacity of digital media to consistently alter and adapt to the virtual user environment.

Additionally, user perceptions of technology may be influenced by collaborative variables, such as those that foster a sense of involvement (Yim et al., 2017). In an augmented-reality shopping scenario, customers may experience different levels of interactivity. For instance, users with high degrees of interaction feel immersed in the environment and usually show high behavioural intentions to use the app (Makhitha & Ngobeni, 2021). On the other hand, consumers with low levels of interaction will probably have low degrees of immersion, which affects their intention to use the app. Thus, we hypothesized.

H5: There is a significant relationship between Interactivity (INT) and Behavioural Intention (BI) to use AR apps among students at the University of the Punjab.

Mediating effect of interactivity

A new aspect of interaction called communication has also been found in earlier research. Communication is defined as how consumers perceive a website to have a two-way conversation feature (Rauschnabel, 2021). For an online transaction to succeed, this capability should be included in the app (Abrar, 2018). Additionally, it can boost clients' confidence to the point where they practically want to make another purchase and recommend the AR app to their friends, peers, and community (Yadav, 2020). This study examines the mediating effect of interactivity between PU, ENJ, and BI. Austomer's ability to interact with a brand through any smart device or application is

strengthened when they find a valuable and enjoyable AR shopping app (Fajriyah et al., 2023). Literacy is a requirement to interact with these technologies and apps. Although most devices and software in the market are compatible, they require literate users. Consequently, it is postulated that,

H6a: Interactivity (INT) mediates the relationship between perceived usefulness (PU) and Behavioural Intention to use AR apps (BI).

H6b: Interactivity (INT) mediates the relationship between perceived enjoyment (PE) and Behavioural Intention to use the AR app (BI).

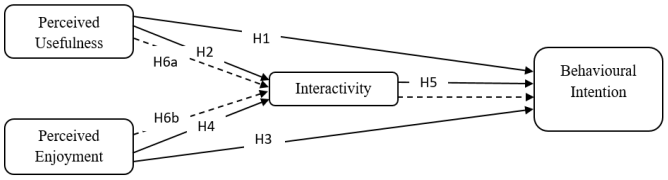

Fig. 2 *Hypothesised framework*

Research Methodology

Questionnaire design, measures, and data collection

This study aims to identify the factors that affect consumers' behavioural intention to use augmented reality apps for purchasing in Pakistan, a developing nation. A research model with four latent variables is developed to accomplish the objective of the current empirical investigation. The study employed a quantitative technique that mainly required data collection to test the research model. The questionnaire was created with questions from previously published studies that had been validated and used. A few items were reworded by self-administration to better reflect the current analysis's viewpoint. The business administration department at the University of the Punjab employed an online questionnaire survey to gather relevant data from executive master's students. This study employed the Likert scale, operationalizing each concept using items that had a 5-point scale (1 being "strongly disagree" and 5 being "strongly agree"). After setting up a completely controlled environment and allowing the students to use AR apps on their phones in the lab—whether they were for furniture AR apps like IKEA, footwear AR apps like Adidas, makeup AR apps like Loreal Makeup, or eye wearable AR apps like Lenskart—the researcher received 252 responses from the students in less than two months. The respondents' demographics are displayed in table 1.

Table I
Demographics

Profile	Frequency	Percentage
Gender		
Male	154	61.10%
Female	98	38.90%
Age		
18-24	93	37.30%
25-34	150	59.58%
35-44	6	2.20%
Above 44	3	1.10%
Occupation		
Student	74	29.20%
Business Owner	51	20.23%
Job Holder	124	49.40%
Others	3	1.17%

The questionnaire was divided into two pieces. The first section covered the introduction and the demographics; the second half included all of the constructs and the elements that went along with them. The perceived usefulness six-item scale was adapted from (Davis et al., 1989); for enjoyment, the four-item scale was adapted from (Pandey & Chawla, 2019); for interactivity, four-items scale was adopted from Pantano et al. (2017) and for behavioural intention to use five-items scale was adapted from Ahn et al. (2004) respectively.

Data Analysis & Results

Measurement model

This study used internal consistency reliability convergent and discriminant validity to assess the measurement model. Cronbach's alpha and composite reliability were used for internal consistency reliability. Internal consistency reliability is shown in Table 2, where all the constructs have satisfactory values, such as Cronbach's alpha and composite reliability ≥ 0.7.

Table II
Validity and reliability of constructs

	Cronbach's Alpha	CR	AVE
BI	0.868	0.872	0.656
ENJ	0.88	0.886	0.736
INT	0.773	0.854	0.595
PU	0.893	0.895	0.651

Average Variance Extracted (AVE) measures the convergent validity of the constructs. Table 2 shows that the AVE value of all the constructs meets the threshold value of AVE ≥ 0.5.

This study used the Heterotrait-Monotrait (HTMT) ratio criterion to measure the discriminant validity. Table 3 shows that the constructs used in this study are validated, as all the values are under 0.85.

Table III
Heterotrait-Mootrait (HTMT)

	BI	ENJ	INT	PU
BI				
ENJ	0.727			
INT	0.728	0.774		
PU	0.649	0.629	0.739	

Structural model

The structural model was the second analysis this study conducted, but before analyzing the structural model, this study tested the multicollinearity issue. This study used VIF value to assess the multicollinearity. Table 4 shows no multicollinearity issue, as all the values were under the threshold value of

Table IV
Collinearity statistics (VIF)

	BI	ENJ	INT	PU
BI				
ENJ	1.856		1.465	
INT	2.046			
PU	1.746		1.465	

There was no collinearity issue, so this study analyzed the relationship between the constructs. Table 5 shows all the direct relationships.

Table V
Direct relationship

	β-value	Standard Error	t-Statistics	p-value	Decision
ENJ -> BI	0.36	0.082	4.4	0	Significant
ENJ -> INT	0.437	0.062	7.096	0	Significant
INT -> BI	0.229	0.077	2.966	0.003	Significant
PU -> BI	0.232	0.082	2.826	0.005	Significant
PU -> INT	0.371	0.065	5.706	0	Significant

The results show a significant relationship between perceived enjoyment and behavioural intention (β = 0.360; t-value = 4.40) with a p-value < 0.05, which indicates that H1 was approved. The relationship between perceived enjoyment and interactivity was also supported

by (β = 0.437; t-value = 7.096) and p-value < 0.05. Further, this study identified a significant relationship between perceived usefulness and behavioural intention (β = 0.232; t-value = 2.826) and$p$-value < 0.05. The relationship between perceived usefulness and interactivity was significant β = 0.371; t-value = 5.706) and p-value < 0.05. Moreover, this study identified a significant positive relationship between interactivity and behavioural intention with (β = 0.229; t-value = 2.966) and p-value < 0.05.

This study also examined the mediating effect of interactivity among the relationships of perceived enjoyment, perceived usefulness, and behavioural intention. Table 6 shows the mediating relationships.

Table VI
Mediating relationship

	β-value	Std. Error	t-Statistics	Decision	Confidence Interval	
					LL	UL
ENJ -> INT -> BI	0.1	0.038	2.646	Supported	0.307	0.546
PU -> INT -> BI	0.085	0.033	2.612	Supported	0.252	0.508

The results show that interactivity plays a significant mediating role in the relationship between perceived enjoyment and behavioural intention with (β = 0.10; t-value = 2.646), p-value < 0.05, and confidence interval (LL = 0.307, UL = 0.546). Similarly, interactivity plays a significant mediating role between the relationship of perceived usefulness and behavioural intention with (β = 0.085; t-value = 2.612), confidence interval (LL = 0.252, UL = 0.508), and p-value < 0.05. Hence, both mediating hypotheses were approved in this study.

Discussion & Conclusion

The formulated hypotheses (H1 to H6b) were constructed based on an extensive literature review encompassing Augmented Reality (AR) technology, its Perceived Usefulness (PU), Perceived Enjoyment (PE), Interactivity (INT), and their influence on the Behavioural Intention (BI) to use AR apps among university students. The empirical investigation revealed significant relationships aligning with the proposed hypotheses. Perceived Usefulness (PU) was found to play a pivotal role in shaping users' intentions to adopt AR apps, validating earlier studies. Similarly, Perceived Enjoyment (PE) notably influenced' behavioural intentions; past studies such as (Kowalczuk et al., 2021; Nhan et al., 2022) also approved of the relationship.

The results broadly align with prior research, underscoring the significance of Perceived Usefulness (PU) and Perceived Ease of Use (PE) in influencing behavioural intentions. This observation is in line with the Technology Acceptance Model (TAM) and analogous studies exploring technology adoption trends. The significance of engaging user experiences in AR app adoption was reinforced by the mediating role of Interactivity (INT) between PU/PE and BI. This finding aligns with recent studies on technology interaction and consumer behaviour, highlighting the importance of user engagement (Abrar, 2018; Fajriyah et al., 2023; Rauschnabel, 2021; and Yadav, 2020).

The empirical investigation conducted in the study revealed a significant influence of perceived utility, perceived enjoyment, and interactivity on university students' intentions to utilize AR apps. These findings affirm the importance of user-centric experiences in technology adoption. This research enhances existing literature by extending established models like TAM and integrating AR-specific components to offer deeper insights into user adoption behaviour within the realm of AR applications. The practical implications of this study offer valuable insights for businesses and app developers, emphasizing the creation of AR apps that prioritize user enjoyment, usefulness, and interactivity to increase adoption rates and user engagement.

This study enhances the theoretical landscape by incorporating AR-specific components into established models such as TAM. The mediating effect of interactivity elucidates how engaging user experiences influence the adoption of AR apps, extending the understanding of technology adoption within academic frameworks. Enterprises and marketers can utilize these discoveries to create augmented reality (AR) applications that prioritize perceived utility and enjoyment, thereby nurturing interactive user engagements. Understanding the pivotal role of these factors can aid in enhancing user engagement and adoption rates among consumers.

Limitations & future research

While this study provides valuable insights, it is not without limitations. The study primarily focused on university students at a specific institution. Extrapolating the results to a wider demographic or diverse population should be approached with caution due to potential discrepancies in technological proficiency, preferences, or usage patterns. The research adopted a cross-sectional design, capturing a snapshot of user perceptions at a specific time. A longitudinal study could provide insights into how the adoption and behaviour of AR apps evolve over an extended period, capturing their dynamic nature.

The study's context was limited to a specific geographical location and educational setting. Broadening the scope of research to encompass diverse industries, cultural contexts, or age groups may provide a more thorough insight into the adoption of AR apps. Although

established scales were utilized to measure constructs, self-reported measures might introduce response biases. Investigating alternative measurement tools or integrating qualitative and quantitative methodologies may help alleviate such biases.

Investigating how different demographic groups (age, gender, socio-economic status) perceive and adopt AR apps could provide insights into nuanced adoption behaviours and preferences. Engaging in longitudinal studies aimed at monitoring users' perceptions and behaviours over an extended period would provide a more profound insight into the enduring effects and progression of AR app adoption. Comparing AR app adoption behaviours across diverse industries or cultural settings could elucidate context-specific factors influencing adoption rates and user engagement. Subsequent studies might investigate the integration of nascent technologies (e.g., Virtual Reality, Artificial Intelligence) with AR applications and their impact on user experiences and adoption patterns. Investigating the role of user experience design elements (interface design, content presentation, personalization) on AR app adoption could offer insights into optimizing user engagement. Exploring ethical implications, privacy concerns, and security perceptions of AR app usage could address user apprehensions and contribute to responsible technological advancements.

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