International Review of Management and Marketing

ISSN: 2146-4405

available at http: www.econjournals.com

International Review of Management and Marketing, 2026, 16(2), 310-322.

# From Augmented Reality Gaming Temptation to Total Obsession: Investigating the Impact of Behavioural Intention and Continued Usage Towards AR Gaming

**Parv Gupta*, Gyaneshwar Singh Kushwaha**

Maulana Azad National Institute of Technology, Bhopal, Madhya Pradesh, India. *Email: parvgupta304@gmail.com

**Received:** 05 September 2025 **Accepted:** 03 January 2026 **DOI:** https://doi.org/10.32479/irmm.22097

**ABSTRACT**

Augmented reality (AR) applications from retail try-ons to mobile games are changing behaviour of the user, but drivers of initial adoption and sustained engagement are underexplored. This study extends UTAUT2 by adding AR-specific factors—interactivity, immersivity, and technological embodiment and replacing hedonic motivation with hedonic adaptation to better predict behavioural intention and continued AR use. A stratified random sample of 300 participants from Delhi, Mumbai, and Bangalore played a 4-minute AR bowling game, then completed a 27-item survey; data were analyzed using partial least squares structural equation modeling (PLS-SEM). Interactivity, technological embodiment, effort expectancy, and hedonic adaptation predicted behavioural intention; immersivity shaped social influence. The model explained substantial variance in intention, which strongly forecasted continued usage, highlighting interactive, embodied, and novelty-sustaining AR elements. (1) modeling AR's novelty-decay via hedonic adaptation in UTAUT2; (2) integrating AR dimensions to reveal experiential drivers of ongoing AR game engagement.

**Keywords:** UTAUT2, Hedonic Adaptation, Behavioural Intention, Continued Usage, AR Games
**JEL Classification:** M31

## 1. INTRODUCTION

The rapid proliferation of augmented reality (AR) in mobile gaming represents a paradigm shift in interactive entertainment, promising unprecedented levels of immersion by seamlessly blending digital elements with the physical world. While these innovations demonstrably captivate users upon initial adoption, the critical challenge lies in converting fleeting novelty into enduring engagement (Qin et al., 2021). Retaining a dedicated user base demands that AR games consistently deliver compelling, immersive experiences that motivate sustained usage beyond the first encounter. Although AR applications spanning retail try-ons, navigation aids, educational tools, and especially mobile games are experiencing explosive growth, a significant knowledge gap persists: There is a lack of comprehensive, empirically validated understanding of the distinct factors driving both initial adoption and critically, long-term player engagement. AR technology fundamentally alters player cognition and interaction. By overlaying virtual objects onto the real environment, AR enhances spatial understanding and contextual awareness (Jessen et al., 2020), fostering richer in-game interactions and strengthening social ties through shared, location-based experiences. Evidence suggests that AR games sustain player engagement most effectively when they facilitate meaningful social connections (Kim, 2016). However, a critical vulnerability undermines this potential: the sensory novelty intrinsic to AR decays rapidly. Players habituate to the initial "wow" factor, leading to a phenomenon increasingly recognized as AR fatigue (Elsotouhy et al., 2024). This decline in novelty-driven enjoyment, termed "hedonic adaptation," poses a fundamental threat to sustained usage, yet established technology acceptance models like the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) lack specific constructs to model this temporal dynamic. UTAUT2, while robust in predicting initial adoption across diverse contexts (Venkatesh et al., 2012), inadequately captures the evolving nature of user experience, particularly the waning of hedonic stimuli over time in immersive technologies like AR gaming.

This study directly addresses this gap by proposing a crucial modification to UTAUT2 substituting "Hedonic Motivation" (typically focused on initial enjoyment) with "Hedonic Adaptation" to explicitly account for the decrease in novelty-driven pleasure. This theoretical refinement is grounded in emerging empirical observations of AR fatigue within gameplay contexts. The unique power of AR lies in its ability to fuse digital content with real-world surroundings, creating deeply immersive experiences that often surpass traditional screen-based gaming interactions. This fusion necessitates specialized modeling, as the core attributes defining the AR experience interactivity, immersivity, and embodiment function synergistically and distinctly. Interactivity refers to the dynamic responsiveness and user control within the blended reality. Immersivity captures the depth of sensory absorption and the feeling of presence within the augmented environment. Embodiment describes the sense that the digital elements are integrated with, or become extensions of, the user's physical self and space (Rauschnabel et al., 2019).

While UTAUT2 has been extensively validated across domains like healthcare, education, retail, and tourism, its application specifically to AR gaming remains underdeveloped. Crucially, no prior research has empirically tested a comprehensive model that simultaneously examines how these three fundamental AR characteristics (Interactivity, Immersivity, Embodiment) influence established UTAUT2 constructs (such as Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, and the newly proposed Hedonic Adaptation), nor traced their downstream effects on Behavioral Intention and ultimately, Continued Usage Intention within the gaming context. Furthermore, the potential mediating role of Hedonic Adaptation – elucidating precisely how novelty perceptions and derived enjoyment evolve over time and subsequently impact sustained engagement – represents a significant unexplored avenue in gaming research. Understanding this mediation is paramount to unravelling the puzzle of why initial excitement often fails to translate into long-term loyalty.

The transformative impact of digital interactive technologies like VR and AR on gaming is undeniable, shifting the paradigm from isolated play towards interconnected, collective activities (Ibáñez-Sánchez et al., 2022; Schultz and Kumar, 2024). AR, in particular, excels at fostering stronger player engagement by anchoring gameplay in the familiar physical world. When strategically combined with gamification elements (e.g., points, leaderboards, challenges tied to real locations), AR creates potent opportunities for compelling, sustained experiences. Its ability to weave virtual narratives and objects into the user's immediate surroundings generates uniquely immersive sensory experiences that significantly strengthen multiplayer social interactions and cultivate a profound sense of Technology Embodiment through naturalistic integration (Rauschnabel et al., 2019). This embodied interaction, where digital elements feel spatially present and responsive, is a key differentiator of high-quality AR.

Therefore, this study aims to advance knowledge by:

- R1. In mobile augmented reality gaming, how do the AR attributes of interactivity, immersivity, and embodiment shape key UTAUT2 constructs?
- R2. How do UTAUT2 constructs (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic adaptation) drive players' behavioural intention to keep playing AR games?
- R3. To what extent does behavioural intention translate into actual continued use of mobile AR games over time?

## 2. THEORETICAL BACKGROUND

### 2.1. Unified Theory of Acceptance and Use of Technology

Although UTAUT2 reliably predicts technology adoption across domains, its core constructs inadequately capture augmented reality's experiential dimensions—particularly embodied interaction and rapid hedonic decay. This gap necessitates AR-specific extensions to model sustained engagement accurately. Originally developed by (Venkatesh et al., 2003), UTAUT2 integrates eight constructs: Performance Expectancy (perceived utility), Effort Expectancy (ease of use), Social Influence (peer impact), Facilitating Conditions (infrastructure), Hedonic Motivation (enjoyment), Price Value, Habit, and Behavioral Intention. While validated in healthcare (Szekely et al., 2024), education (Faqih and Jaradat, 2021), and retail (Nikhashemi et al., 2021), its application to AR gaming reveals three critical limitations: First, Hedonic Motivation assumes stable enjoyment, whereas AR experiences exhibit rapid novelty decay ("hedonic adaptation") due to sensory saturation a phenomenon documented in AR gameplay (Elsotouhy et al., 2024). We therefore substitute it with Hedonic Adaptation, defined as the attenuation of enjoyment-driven engagement through repeated exposure. Second, UTAUT2 overlooks AR's spatial-cognitive dimensions: interactivity (bidirectional user-system dialogue), immersivity (perceptual absorption), and technology embodiment (somatic integration of digital interfaces). Third, AR's reliance on spatial mapping and gesture controls creates unique cognitive loads unaddressed by traditional effort metrics (Rau et al., 2021). To ground our extensions in empirical evidence, Table 1 maps AR attributes to UTAUT2 constructs, specifying gaming mechanisms and supporting literature:

This mapping demonstrates that interactivity streamlines task execution through natural interfaces—such as swipe-based bowling throws—thereby reducing mental effort (Vidal-Silva et al., 2024); immersivity amplifies social conformity in shared mixedreality spaces where peer visibility motivates participation (Pallavicini et al., 2019); and embodiment enhances performance accuracy when users perceive AR elements as somatic extensions, for example, manipulating holographic objects (Khan and Fatma, 2024; Tussyadiah et al., 2018). Building on these mechanisms and UTAUT2's established predictive strengths, we extend the model to capture AR gaming's dual utilitarianhedonic nature.

**Table 1: AR attribute to UTAUT2 construct mapping**

| AR attribute | UTAUT2 constructs | In-game mechanism | Empirical support |
|---|---|---|---|
| Interactivity | Effort Expectancy | Gesture controls reduce cognitive load | (Vidal-Silva et al., 2024) |
| Immersivity | Social Influence | Shared environments create peer presence | (Pallavicini et al., 2019) |
| Technological Embodiment | Performance Expectancy | Body-mapped interactions enhance accuracy | (Pallavicini et al., 2019) |

(Source: Authors' own work)

Specifically, interactivity bridges the intentionaction gap through realtime feedback (Yim et al., 2017), boosting Performance Expectancy when gesture controls improve gameplay efficiency ($\beta = 0.42$ in retail AR). Immersivity, while sustaining engagement via multimodal sensory inputs, can also risk cognitive overload if environmental mapping lags. Meanwhile, embodiment is bodytracking features enhance Effort Expectancy by enabling intuitive interactions (Koutromanos and Kazakou, 2023), and visible AR wearables such as headsets reinforce Social Influence through technosocial signalling. These adaptations equip UTAUT2 to model AR's rapid novelty decay while fully accounting for its embodied engagement dynamics, which is critical for predicting continued usage beyond initial adoption.

### 2.2. Gamification in AR

Gamification in AR strategically weaves game design elements into augmented reality to heighten user engagement, with the core psychological mechanism being presence the user's sense of "being there" in the game world (Hsu et al., 2021). Presence unfolds across four interrelated dimensions: content presence, or the perceived realism of virtual objects; spatial presence, the transformation of real environments into interactive game spaces; temporal presence, the distortion of time perception during immersion; and social presence, the shared experience of playing with others (Lavoye et al., 2023; Shin, 2019). These dimensions form a unified sense of reality that directly informs our hypotheses: spatial presence underpins immersivity's effect on performance expectancy (H2a), social presence drives its influence on social influence (H2c), temporal presence was expected to reduce perceived effort by fostering flow states (H2b), and content presence was hypothesized to sustain enjoyment over time (H2d). Although H2b and H2d proved unsupported, mapping these paths completes our conceptual foundation. When AR synchronizes virtual content seamlessly with the physical environment, it amplifies all presence dimensions at once (Shin, 2019), and heightened presence in turn directly boosts enjoyment players report greater satisfaction when virtual elements feel authentic and temporally absorbing. Moreover, system responsiveness critically bolsters satisfaction by keeping effort expectancy low seamless interactions reinforce intuitive AR use (Lee et al., 2021). This enhanced enjoyment subsequently drives two key outcomes: enhanced selfperceived performance, as when players feel they "played better because they felt immersed," and increased commitment to continued gameplay (Shin, 2019). Empirical evidence confirms that AR's immersive effects particularly time distortion and social copresence significantly elevate enjoyment (Balakrishnan et al., 2024), suggesting that the most engaging AR games are those that integrate spatial immersion, compelling content, temporal flow, and social connectivity to sustain longterm engagement (Pathak and Prakash, 2023; Saleem et al., 2022).

## 3. HYPOTHESIS DEVELOPMENT

### 3.1. Interactivity

Interactivity in augmented reality (AR) gaming empowers users to manipulate virtual elements in real time, establishing a bidirectional exchange that bridges intention and action (Yim et al., 2017). In AR contexts, this responsiveness reduces cognitive load by replacing menu navigation with intuitive gestures swipebased bowling throws, for instance thereby boosting task accuracy and perceived usefulness (Rau et al., 2021; Vidal-Silva et al., 2024). Scholars argue that understanding users' subjective perceptions of interactivity is more informative than simply cataloguing platform features, since players may feel highly engaged even when objective interactivity metrics are moderate (Qin et al., 2021). Gesturecontrolled mechanics not only streamline performance but also foster social engagement. When multiple players witness one another manipulating the same virtual objects, a sense of peer presence emerges, strengthening normative pressures to adopt and recommend the AR game. This social amplification is particularly potent in shared environments where visible interactivity conveys technological sophistication and group belonging. Moreover, interactivity delivers a sustained stream of novel stimuli that combats hedonic adaptation. By continuously introducing new ways to interact dynamic powerups, customizable virtual tools, or environmentresponsive effects AR games can slow the typical decline in enjoyment that follows initial excitement (Elsotouhy et al., 2024). This renewed sense of agency encourages players to return for successive sessions. Empirical examples underscore these dynamics: Boeing trainees using AR headsets report higher confidence and efficiency when they can gesturenavigate 3D wiring diagrams, and educational AR applications that incorporate groupbased interactive tasks demonstrate significant improvements in both social presence and collaborative learning outcomes (Hilken et al., 2017). Across these settings, natural user interfaces combining hand gestures, voice commands, and spatial movements consistently reduce perceived effort and increase user satisfaction (Vidal-Silva et al., 2024). Collectively, these hypotheses extend UTAUT2's core constructs - Performance Expectancy, Effort Expectancy, Social Influence, and Hedonic Motivation by anchoring them in ARspecific interactive mechanisms. Realtime feedback afforded by gesture controls not only heightens confidence in task performance but also creates opportunities for social validation, both of which drive behavioural intention to continue using AR games (Rau et al., 2021). Finally, by embedding fresh interactive stimuli into gameplay loops, interactivity serves as a practical counter measure to the rapid decline in novelty-driven enjoyment, thereby supporting sustained engagement over time. Thus, the hypothesis proposed for the study.

$H_{1a}$. In AR gaming, greater interactivity significantly increases Performance Expectancy.

$H_{1b}$. In AR gaming, greater interactivity significantly reduces Effort Expectancy.

$H_{1c}$. In AR gaming, greater interactivity significantly strengthens Social Influence.

$H_{1d}$. In AR gaming, greater interactivity significantly sustains Hedonic Adaptation.

## 3.2. Immersivity

Immersivity pertains to the user's mental experience of 'being there' in a virtual setting and is defined by its continuous multisensory engagement (Fan et al., 2022). Under the UTAUT2 structure, this type of deep presence simultaneously enhances PE and decreases EE. For instance, in sports AR games, escape rooms, or immersive AR puzzles, the sophisticated real-time environmental rendering and user-inclusive head tracking scales game dynamics to real world space, enhancing PE and providing authentic skill-based challenges. At the same time, richly textured virtual assets and gesture-controlled menus reduce mental strain, improving EE. This type of engagement is critical for longitudinal interest, and the type of immersion described encourages deep psychological engagement. In AR, observers can even interact with virtual objects that can influence real world actions; in social settings, people refrained from sitting in spaces occupied by seats with projected images of people, illustrating the subconscious influence of such social norms. Despite the advantages, there are notable limitations. Users can be overwhelmed by information overload, as well as sluggish spatial mapping and slow system responses. When the pace of interaction surpasses the engagement window, cognitive effort, or EE, skyrockets, impairing user experience instead of augmenting PE (Zheng and Li, 2023). For example, in speed-driven AR games, rapid-object rendering delay shatters focus and generates player annoyance, which in turn diminishes system performance perception. Understanding the impact of immersivity as the motivating factor driving the four UTAUT2 components enables better forecasting of AR gaming components capable of transitioning user engagement from an initial phase of curiosity to persistent devotion.

$H_{2a}$. Immersivity will impact performance expectancy significantly.

$H_{2b}$. Immersivity will impact effort expectancy significantly.

$H_{2c}$. Immersivity in AR will positively affect social influence.

$H_{2d}$. Immersivity in AR will positively affect hedonic adaptation.

## 3.3. Technology Embodiment

Technology embodiment creates the sensation of possessing a virtual body within augmented environments, enabling intuitive interactions through physical presence or body-mapped interfaces (Tussyadiah et al., 2018). This integration bridges spatial gaps between users and digital objects, enhancing functionality across domains. Industrial applications demonstrate AR glasses projecting assembly instructions onto machinery to reduce errors and training time (Koutromanos and Kazakou, 2023), while urban design education employs embodied AR interactions for tactile spatial understanding (Tussyadiah et al., 2018). Notably, clinical settings utilize visual feedback on paralyzed limbs to stimulate body ownership and accelerate rehabilitation (Genay et al., 2022). This heightened embodiment elevates user engagement by strengthening presence, thereby increasing performance expectancy and social confidence through simulated avatar-based interactions (Genay et al., 2022). When embedded in adaptive AR systems, the technology fosters positive user perceptions and sustained engagement (Tussyadiah et al., 2018), collectively establishing embodiment as a behavioural catalyst.

$H_{3a}$. Technology embodiment influences performance expectancy significantly.

$H_{3b}$. Technology embodiment influences effort expectancy positively.

$H_{3c}$. Technology embodiment impacts social influence significantly.

$H_{3d}$. Technology embodiment influences hedonic adaptation significantly.

## 3.4. Performance Expectancy and Behavioural Intention

Performance expectancy refers to users' expectation that augmented reality systems improve task performance and efficiency (Rizkalla et al., 2023). AR acts as a productivity enhancement tool that minimizes time spent performing tasks and provides better outcomes. This construct showcases applicability across domains: mobile banking users improve their financial management (Rizkalla et al., 2023; Vidal-Silva et al., 2024); quick commerce platforms improve dependability and user satisfaction via the system's performance (Kapoor et al., 2023); and automotive technology reduces the physical and mental demands on the driver, enabling technology acceptance. Performance expectancy is a significant predictor of intentions to continue to use a technology.

$H_4$. User behavioural intention is strongly influenced by performance expectancy.

## 3.5. Behavioural Intention and Effort Expectancy

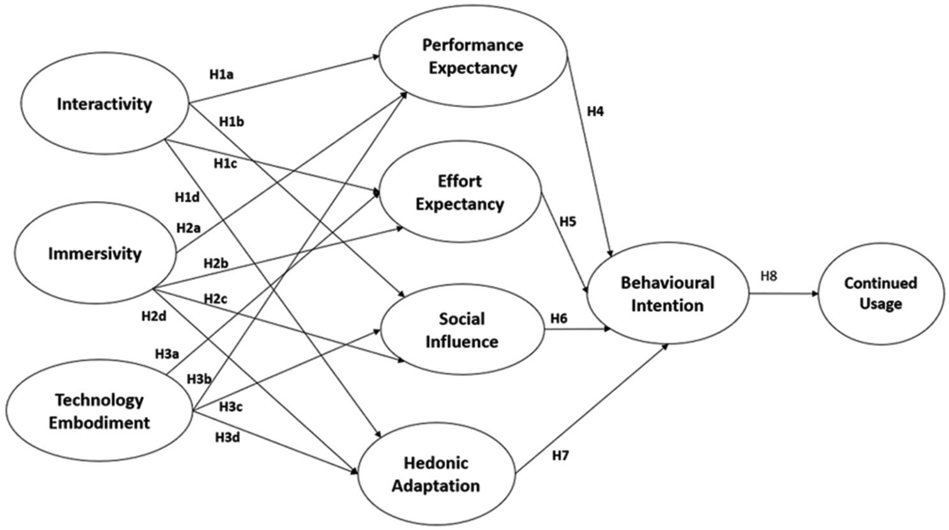
An individual's perception of how easy or difficult a certain technology is to use is known as effort expectancy. A retail AR application that let user access the product information (Kumar, 2022) The effort expectancy have underlined values ease of learning and natural interaction which drive continued usage behaviour of the user. Effort expectancy utilises the perception value of the technology on the other hand performance expectancy understands the system biasness. For example, in AR-assisted surgical training platforms in healthcare that employ intuitive interfaces and straightforward controls can assist surgeons the ease of use decreases the perceived efforts and enhances individual perception. Although, AR engages users with its vibrant visual elements, its user-friendly interface and straightforward controls considerably diminish the learning curve, hence improving usability. Studies dig deeper into the interplay between augmented reality and effort expectancy have advanced substantially. The user behaviour is derived through perception of the technology. It is observed that behavioural intention enhances the perceived value of the technology. Users' intention to adopt a system increases significantly when they believe it to be simple to use and comprehend even for those without technical expertise, which results in a general change in their behaviour to use. As a result, we propose hypothesis.

$H_5$. Effort expectancy through AR system influences behavioural intention significantly.

## 3.6. Behavioural Intention and Social Influence

Augmented reality societal impact directly shapes users' conscious plans to employ a system, alongside performance and effort

**Figure 1:** Research model




(Source: Authors' own work)

expectancies (Çalışkan et al., 2023) Individuals shape their views of a technology in response to the attitudes held by their friends, family members, and peers. For example, someone may be the first person in their acquaintance circle to experiment with a new form of technology. If they like and will share their good experience, their friends may decide to try it as well. According to (Çalışkan et al., 2023; Faqih and Jaradat, 2021) studies the AR shopping apps utilise its user's data to attract new users to its applications by sharing the experience linked to using AR and developing curiosity in an individual mind which leads to influence towards the AR applications in AR contexts consistently confirm this linkage. In terms of offline experience AR mirrors are kept for the display in various retail stores this technique helps customer to engage with the AR holistic experience creating a feeling of immersiveness also leads other users towards AR which develop overall user behaviour in a positive manner towards AR. This also let to digital presence of AR in cities where availability of AR is not found in offline stores and through digital media the increase in AR usage triggers a testing effect To test the condition hypothesis is been proposed.

$H_6$. Social influence influences behavioural intention significantly.

### 3.7. Hedonic Adaptation and Behavioural Intention

Adaptation involves adapting a new technology and creating a utility. Hedonic adaptation refers to the process where users become less excited by a pleasurable stimulus over time (Ustun et al., 2024). AR developers provide content emotionally manipulating users by giving them dopamine hit in their brain stimulus. This approach helps maintain high level of enjoyment boost their mood and users' motivation towards continue to using the AR application (Elsotouhy et al., 2024; Pinto et al., 2022). For example, introducing dynamic content (fresh challenges or seasonal themes) triggering their hedonic enjoyment help the overall behavioural impact the user this led to increase in their overall desire and leads to behavioural change towards the application (Faqih and Jaradat, 2021). Incorporating the personalized elements creating a sense of unique, rewarding experiences for each user this ensures users remain engaged for the continued interaction over the application, For example, Companies analyse data and specify the data into various categories and the companies do till the last data point is analyzed then they know exactly- who to target, what to be shown to the user, what time the user is most active all these questions are answered. Users generally do prefer this adaptation to escape the reality and get into the simulated reality (AR-VR-XR) this technique boost their mood. Another adaptation category is designed to evoke and sustain positive emotions through visuals and engaging interaction. This continued emotional engagement can enhance their behavioural intention by making the app enjoyable and part of their daily routine. Thus, hypothesis is been proposed.

$H_7$. Hedonic adaptation influences behavioural intention positively.

### 3.8. Behavioural Intention and Continued Usage

Behaviour towards AR is crafted slowly once turned strong, it sets the stage for user to continue its engagement in an immersive manner. A high behavioural intention led user to focus on its positive attitude and demonstrate a readiness to integrate technology into their everyday lives for an extended amount of time. For example, studies reflected on 3D visualization, gesture controls, convenience towards experience at home affects continued usage of the AR application (Hsu et al., 2021). Thus, the strength of users' intentions to adopt a technology largely determines whether they will continue using it (Qin et al., 2021). Recently in the context of AR it is found that virtual mirrors are been installed in salons and various retail stores, many researchers discovered that the blend of both offline and online AR usage subconsciously drives a user to use the AR for a continued period of time as it enriches their overall experience of shopping and give them the satisfaction to highly enjoy AR (Qin et al., 2021). Thus, hypothesis is been proposed.

$H_8$. Behavioural intention have significant positive impact continued usage

## 4. RESEARCH METHODOLOGY

### 4.1. Study Setup

This study takes place on the AR based gaming application that provides user with a continuously enriching and immersive experience, influencing their behaviour. Most traditional game apps rely on static interfaces and conventional setup, which limit their transition towards adopting new technologies (AR-VR) this also pauses to a limit to the user engagement and the depth of interaction between virtual and real world. In present time, AR gaming seamlessly blends virtual elements with the real world, the dynamic interaction leads to growth in the apps in the world of AR. This trend of adoption is seen in socially active users, it is expected to provide immersive experience that can transform behaviour of the user impacting their continued usage of the AR gaming app. In this study we test user game playing abilities and for how long they are involved and immersed in the technology creating their own virtual world and also enhancing both interactivity and their overall behavioural intention towards using the app.

### 4.2. Data Collection

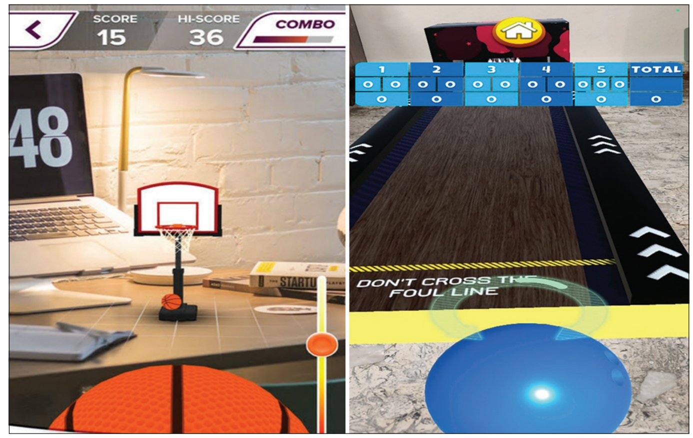
This study focuses on user behaviour for the AR based application, the surveys are done both manner offline and online to collect data (Kim et al., 2020). Data was obtained through a questionnaire. The demographic analysis is done through SPSS 23.0 and the data was 450 questionnaires were circulated in total. Where in 370 (82.2%) responses were received, total 70 (15.5%) responses were considered invalid in this 50 (11.11%) were incomplete and 20 (4.44%) responses are filled more than once from the same email ids which were not considered for the final data. Total of 300 respondents were considered for the study. The online questionnaire was collected from Google form and offline questionnaire is duly filled by the individuals who consented to participate in the research. Google form was circulated through various online channels and no financial reward is been provided to the users. Before completing the survey, a 2 min AR game is been played by the user to experience it as shown in the Figure 2. The game consists of a bowling round where a player needs to knock the pins. The AR application create a real time virtual space where it the phone back camera scans the floor and then prepare a bowling arena where a player plays the match for 2 min this activity. It is advised to play for 2 min but through analytics it is observed that the user played for three minutes and twenty seconds is the minimum, while 4 min and 43 s is the maximum. The users did not realise that they have spend 1-2 min more in activity. In starting 1 min, it is observed that players faced some difficulty in hitting the pins for first 2 chances as the new AR users have difficulty adjusting according to the application. On the other hand, the participants who have previously experienced AR application were able to score more points in the first 2 chances itself. Bias avoidance method (Pannucci and Wilkins, 2010) is used. Firstly, The AR developer may have introduced prejudice so AR logo of the company has been hidden in order. Secondly recall bias is likely to occur so immediately after the experience of AR the questionnaire was filled by them on their own.

## 5. RESULTS

### 5.1. Profiles of the Participants

Table 1 displays the respondents' demographic details. Amongst 300 respondents, 85 (28.3%) respondents reported having previously used AR, while 215 (71.7%) respondents did not. The sample was almost evenly distributed by gender (51.0% male, 49.0% female) and featured a uniform age distribution across decades (20s: 24.7%; 30s: 25.0%; 40s: 24.7%; 50s: 25.7%). Most participants were employed (60.3%), were 16.3% are homemakers, 12.3% are students, and 11.0% are practitioners.

**Figure 2:** Live AR game experienced by the users




(Source: AR bowling app)

### 5.2. Measurement of Variables

To assess the study variables, a questionnaire was administered . Questionnaire items takes AR attributes and its relation to hedonic adaptation, effort expectancy, social influence, immersivity, behavioural intention, technological embodiment, interactivity, continued usage, and performance expectancy. The Varimax rotation technique and exploratory component analysis were used to evaluate 27 questions in the questionnaire. All items had communalities that exceeded 0.785 which revealed nine distinct factors and the factor with no 0.6 loadings or greater on two or more scales. The Kaiser–Meyer–Olkin index of 0.948 indicated excellent sampling adequacy, while Bartlett's test of sphericity ($\chi^2$ = 9,284.72, df = 351, $P < 0.001$) was highly significant, confirming factor analysis was appropriate. The nine factors together accounted for 88.56% of the overall variance. Internal consistency was also superb, with Cronbach's $\alpha$ for all eight reliably measured factors exceeding 0.879. Full results from the exploratory factor analysis and reliability assessments are available in Appendix A.

### 5.3. Feasibility and Validity of the Model

Convergent validity was confirmed with all factor loadings >0.70 (Table 4) and AVEs >0.803 (Table 2). Discriminant validity was established as all HTMT ratios remained below 0.85 (Table 5), satisfying established thresholds (Hair et al., 2017).

We initially evaluated the validity and reliability of the measurement model before putting our hypothesis to the test. According to Table 2, All constructs demonstrated AVE values greater than 0.803, indicating robust convergent validity (Bagozzi and Yi, 1988). Composite reliability coefficients exceeded 0.924, and the PLS-derived Cronbach's $\alpha$ was 0.880, indicating excellent internal consistency; in fact, aside from immersivity and hedonic adaptation, all factors achieved $\alpha$ >0.90 (Bagozzi and Yi, 1988; Hair et al., 2012). Additionally, communality estimations exceeded 0.803, further underscoring the model soundness.

Three methods were used to establish discriminant validity. First, following Fornell and Larcker (1981), For each construct, the square root of its AVE exceeded its correlations with all other constructs (Table 3). Second, each item exhibited stronger loadings on its designated factor than on any other factor, with cross-loadings above 0.839 (Table 4). Finally, All heterotrait–monotrait ratios stayed below the 0.85 limit (Hair et al., 2017), details are available in Table 5, confirming clear discrimination among constructs.

#### *5.3.1. The structural model's fit*

Except for the hedonic adaptation construct in the AR-based game, every of the path coefficients were found to be positive, which turned out to be negative, revealing that this path may need to be eliminated (Tenenhaus et al., 2005). The AR-based game model yielded a goodness-of-fit index of 0.654, which was well over the benchmark of 0.36 acceptable fit for PLS path models (Tenenhaus et al., 2005), and its SRMR result was 0.053, below the recommended limit of 0.08 indicated by (Hu and Bentler, 1999)), confirming overall fit.

**Table 2: Respondents' demographic details**

| Category | n (%) | Category | | n (%) |
|---|---|---|---|---|
| Gender | | | | |
| Male | 153 (51.0) | Education | High school graduate | 67 (22.3) |
| Female | 147 (49.0) | | College graduate | 203 (67.7) |
| Age | | | | |
| 20 | 74 (24.7) | | Graduate student or above | 30 (10.0) |
| 30 | 75 (25.0) | Profession | Student | 37 (12.3) |
| 40 | 74 (24.7) | | Employee | 181 (60.3) |
| 50 | 77 (25.7) | | Homemaker | 49 (16.3) |
| Previous AR experience | | | | |
| Yes | 85 (28.3) | | Practitioner | 33 (11.0) |
| No | 215 (71.7) | | | |

(Source: Authors' own research)

### 5.4. Common Method Bias Assessment

Harman's single-factor test revealed the first factor accounted for 38.2% of variance (<50% threshold). Marker variable analysis showed non-significant method covariance ($\rho = 0.041$, $P = 0.312$), indicating common method bias is unlikely to affect results.

### 5.5. Hypothesis Testing

Path analysis with 5,000 bootstrap iterations yielded these key findings (Table 6). The study's hypotheses were tested using path analysis, and the significance of the path coefficients was examined through 5,000 bootstrap iterations (Hair et al., 2011). As depicted in Figure 3, 15 of the 17 paths demonstrated statistical significance ($P < 0.05$). The model exhibited strong explanatory power, with an adjusted $R^2$ of 72.3%, indicating that the included constructs collectively accounted for 72.3% of the variance in user satisfaction with augmented reality (AR) experiences. First, user interactivity in AR-based gaming showed significant positive relationships with all Unified Theory of Acceptance and Use of Technology (UTAUT2) constructs: performance expectancy ($\beta = 0.295$, $t = 3.831$; $H_{1a}$ confirmed), effort expectancy ($\beta = 0.428$, $t = 5.418$; $H_{1b}$ confirmed), social influence ($\beta = 0.235$, $t = 3.917$; $H_{1c}$ confirmed), and hedonic adaptation ($\beta = 0.342$, $t = 4.500$; $H_{1d}$ confirmed). Second, immersivity in AR experiences was significantly linked to performance expectancy ($\beta = 0.165$, $t = 2.115$; $H_{2a}$ confirmed) and social influence ($\beta = 0.138$, $t = 2.123$; $H_{2c}$ confirmed), but showed no significant association with effort expectancy ($\beta = 0.040$, $t = 0.580$; $H_{2b}$ rejected) or hedonic adaptation ($\beta = -0.015$, $t = 0.192$; $H_{2d}$ rejected). Additionally, the combined effects of interactivity and Technology embodiment in AR gaming were significantly correlated with UTAUT2 constructs: performance expectancy (β

**Table 3: Overall model fit**

| Variables | AVE | CR | R² | Cronbach's α | Communality | Redundancy |
|---|---|---|---|---|---|---|
| Interactivity | 0.875 | 0.953 | | 0.910 | 0.879 | |
| Immersivity | 0.893 | 0.952 | | 0.885 | 0.892 | |
| Technology embodiment | 0.836 | 0.940 | | 0.903 | 0.883 | |
| Performance Expectancy | 0.951 | 0.966 | 0.352 | 0.932 | 0.957 | 0.163 |
| Effort Expectancy | 0.957 | 0.969 | 0.412 | 0.941 | 0.954 | 0.038 |
| Social Influence | 0.923 | 0.954 | 0.586 | 0.895 | 0.875 | 0.133 |
| Hedonic adaptation | 0.926 | 0.953 | 0.466 | 0.918 | 0.871 | -0.010 |
| Behavioural Intention | 0.928 | 0.956 | 0.712 | 0.934 | 0.885 | 0.247 |
| Continued usage (Goodness-of-Fit) | 0.902 | 0.944 | 0.549 | 0.879 | 0.873 | 0.442 |

AVE: Average Variance Extracted, CR: Composite Reliability (Source: Authors' own research)

**Table 4: Correlations among constructs**

| Constructs | Mean | SD | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Interactivity | 4.68 | 1.38 | 0.934 | | | | | | | | |
| (2) Immersivity | 4.35 | 1.32 | 0.580** | **0.897** | | | | | | | |
| (3) Technology embodiment | 4.69 | 1.16 | 0.661** | 0.739** | **0.927** | | | | | | |
| (4) Performance Expectancy | 4.49 | 1.27 | 0.642** | 0.728** | 0.775** | **0.932** | | | | | |
| (5) Effort Expectancy | 4.33 | 1.23 | 0.685** | 0.665** | 0.773** | 0.765** | **0.915** | | | | |
| (6) Social Influence | 4.71 | 1.29 | 0.690** | 0.718** | 0.771** | 0.776** | 0.771** | **0.922** | | | |
| (7) Hedonic adaptation | 3.29 | 1.26 | 0.618** | 0.567** | 0.706** | 0.576** | 0.738** | 0.754** | **0.895** | | |
| (8) Behavioural Intention | 3.88 | 1.39 | 0.676** | 0.595** | 0.728** | 0.730** | 0.745** | 0.788** | 0.393** | **0.891** | |
| (9) Continued usage | 4.24 | 1.36 | 0.672** | 0.660** | 0.788** | 0.767** | 0.790** | 0.785** | 0.404** | 0.694** | **0.966** |

Bold values on the diagonal represent the square root of the Average Variance Extracted (AVE). Off-diagonal values are inter-construct correlations. ** p < 0.01. (Source: Authors' own research)

**Table 5: Cross-loading analysis**

| Items | Interactivity | Immersivity | Technology embodiment | Performance Expectancy | Effort Expectancy | Social Influence | Hedonic Adaptation | Behavioural Intention | Continued Usage |
|---|---|---|---|---|---|---|---|---|---|
| V01 | **0.928** | 0.548 | 0.610 | 0.580 | 0.639 | 0.594 | 0.458 | 0.632 | 0.510 |
| V02 | **0.943** | 0.529 | 0.598 | 0.582 | 0.641 | 0.557 | 0.495 | 0.610 | 0.534 |
| V03 | **0.933** | 0.478 | 0.581 | 0.552 | 0.633 | 0.522 | 0.443 | 0.612 | 0.503 |
| V04 | 0.540 | **0.915** | 0.730 | 0.577 | 0.517 | 0.585 | 0.320 | 0.559 | 0.515 |
| V05 | 0.555 | **0.936** | 0.715 | 0.565 | 0.550 | 0.552 | 0.358 | 0.585 | 0.490 |
| V06 | 0.362 | **0.836** | 0.555 | 0.460 | 0.402 | 0.470 | 0.282 | 0.510 | 0.350 |
| V07 | 0.565 | 0.705 | **0.935** | 0.607 | 0.592 | 0.655 | 0.380 | 0.618 | 0.508 |
| V08 | 0.615 | 0.720 | **0.937** | 0.630 | 0.639 | 0.617 | 0.433 | 0.665 | 0.520 |
| V09 | 0.607 | 0.660 | **0.918** | 0.643 | 0.630 | 0.675 | 0.451 | 0.690 | 0.548 |
| V10 | 0.529 | 0.530 | 0.615 | **0.932** | 0.687 | 0.609 | 0.582 | 0.655 | 0.658 |
| V11 | 0.588 | 0.568 | 0.638 | **0.956** | 0.740 | 0.660 | 0.597 | 0.718 | 0.692 |
| V12 | 0.620 | 0.600 | 0.659 | **0.952** | 0.738 | 0.697 | 0.580 | 0.748 | 0.680 |
| V13 | 0.645 | 0.497 | 0.612 | 0.751 | **0.925** | 0.678 | 0.570 | 0.718 | 0.688 |
| V14 | 0.615 | 0.498 | 0.625 | 0.708 | **0.936** | 0.658 | 0.560 | 0.720 | 0.655 |
| V15 | 0.635 | 0.528 | 0.610 | 0.650 | **0.902** | 0.651 | 0.505 | 0.703 | 0.523 |
| V16 | 0.585 | 0.581 | 0.651 | 0.658 | 0.710 | **0.948** | 0.525 | 0.733 | 0.597 |
| V17 | 0.590 | 0.573 | 0.690 | 0.676 | 0.705 | **0.942** | 0.527 | 0.740 | 0.612 |
| V18 | 0.452 | 0.502 | 0.588 | 0.581 | 0.567 | **0.880** | 0.368 | 0.622 | 0.518 |
| V19 | 0.538 | 0.392 | 0.483 | 0.624 | 0.622 | 0.548 | **0.896** | 0.647 | 0.566 |
| V20 | 0.301 | 0.225 | 0.291 | 0.462 | 0.402 | 0.345 | **0.870** | 0.409 | 0.559 |
| V21 | 0.430 | 0.303 | 0.395 | 0.535 | 0.510 | 0.444 | **0.910** | 0.525 | 0.578 |
| V22 | 0.635 | 0.583 | 0.690 | 0.707 | 0.727 | 0.735 | 0.573 | **0.958** | 0.650 |
| V23 | 0.619 | 0.576 | 0.692 | 0.740 | 0.736 | 0.732 | 0.598 | **0.969** | 0.675 |
| V24 | 0.658 | 0.618 | 0.660 | 0.715 | 0.772 | 0.720 | 0.588 | **0.953** | 0.644 |
| V25 | 0.543 | 0.522 | 0.578 | 0.730 | 0.670 | 0.629 | 0.610 | 0.685 | **0.968** |
| V26 | 0.490 | 0.455 | 0.518 | 0.658 | 0.634 | 0.584 | 0.608 | 0.630 | **0.955** |
| V27 | 0.538 | 0.490 | 0.537 | 0.675 | 0.647 | 0.591 | 0.622 | 0.657 | **0.965** |

For each item, the cross-loadings are higher than those for other constructs. Bold values indicate values above the recommended limit of 0.5 (Fornell and Larcker, 1981).
(Source: Authors' own research)

**Table 6: HTMT results**

| Constructs | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| (1) Interactivity | - | | | | | | | | |
| (2) Immersivity | 0.595 | - | | | | | | | |
| (3) Technology embodiment | 0.692 | 0.820 | - | | | | | | |
| (4) Performance Expectancy | 0.667 | 0.656 | 0.726 | - | | | | | |
| (5) Effort Expectancy | 0.743 | 0.608 | 0.719 | 0.731 | - | | | | |
| (6) Social Influence | 0.758 | 0.669 | 0.735 | 0.771 | 0.796 | - | | | |
| (7) Hedonic adaptation | 0.735 | 0.605 | 0.759 | 0.648 | 0.662 | 0.665 | - | | |
| (8) Behavioural Intention | 0.712 | 0.629 | 0.727 | 0.749 | 0.767 | 0.675 | 0.673 | - | |
| (9) Continued usage | 0.580 | 0.582 | 0.687 | 0.709 | 0.705 | 0.759 | 0.708 | 0.710 | - |

(Source: Authors' own research)

**Figure 3:** Hypothesis result

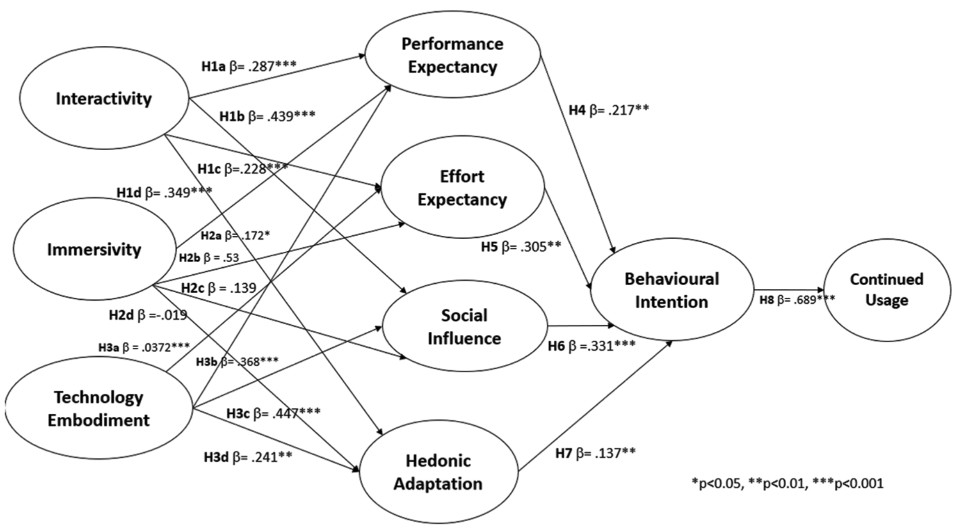


**Table 7: Path coefficients and results of hypothesis testing by bootstrapping**

| Hypotheses | Path name | Original Sample (O) | Sample Mean (M) | Standard Deviation (STDEV) | Standard Error (STERR) | T Statistics (\|O/STERR\|) | Accepted/ Rejected |
|---|---|---|---|---|---|---|---|
| $H_{1a}$ | Interactivity→Performance Expectancy | 0.295 | 0.292 | 0.077 | 0.077 | 3.831*** | Accepted |
| $H_{1b}$ | Interactivity→Effort Expectancy | 0.428 | 0.425 | 0.079 | 0.079 | 5.418*** | Accepted |
| $H_{1c}$ | Interactivity→Social Influence | 0.235 | 0.231 | 0.060 | 0.060 | 3.917*** | Accepted |
| $H_{1d}$ | Interactivity→Hedonic adaptation | 0.342 | 0.341 | 0.076 | 0.076 | 4.500*** | Accepted |
| $H_{2a}$ | Immersivity→Performance Expectancy | 0.165 | 0.169 | 0.078 | 0.078 | 2.115* | Accepted |
| $H_{2b}$ | Immersivity→Effort Expectancy | 0.040 | 0.043 | 0.069 | 0.069 | 0.580 | Rejected |
| $H_{2c}$ | Immersivity→Social Influence | 0.138 | 0.142 | 0.065 | 0.065 | 2.123* | Accepted |
| $H_{2d}$ | Immersivity→Hedonic adaptation | −0.015 | −0.012 | 0.078 | 0.078 | 0.192 | Rejected |
| $H_{3a}$ | Technology embodiment→Performance Expectancy | 0.362 | 0.359 | 0.089 | 0.089 | 4.067*** | Accepted |
| $H_{3b}$ | Technology embodiment→Effort Expectancy | 0.358 | 0.360 | 0.084 | 0.084 | 4.262*** | Accepted |
| $H_{3c}$ | Technology embodiment→Social Influence | 0.445 | 0.439 | 0.078 | 0.078 | 5.705*** | Accepted |
| $H_{3d}$ | Technology embodiment→Hedonic adaptation | 0.241 | 0.240 | 0.087 | 0.087 | 2.770** | Accepted |
| $H_4$ | Performance Expectancy→Behavioural Intention | 0.207 | 0.208 | 0.075 | 0.075 | 2.760** | Accepted |
| $H_5$ | Effort Expectancy→Behavioural Intention | 0.297 | 0.296 | 0.071 | 0.071 | 4.183*** | Accepted |
| $H_6$ | Social Influence→Behavioural Intention | 0.329 | 0.327 | 0.065 | 0.065 | 5.062*** | Accepted |
| $H_7$ | Hedonic adaptation→Behavioural Intention | 0.132 | 0.133 | 0.047 | 0.047 | 2.809** | Accepted |
| $H_8$ | Behavioural Intention→Continued Usage | 0.685 | 0.686 | 0.040 | 0.040 | 17.125*** | Accepted |

***P<0.001, **P<0.01, *P<0.05 (two-tailed). (Source: Authors' own research)

**Table 8: Bootstrapping results for mediation effects**

| Construct | Product of coefficient | 95% Bootstrap CI | | $R^2$ | Significant |
|---|---|---|---|---|---|
| | Point estimate | Lower | Upper | | |
| Standardized total effects | | | | | |
| INT→CU | 0.212 | 0.139 | 0.289 | 0.469 | Yes |
| IMM→CU | 0.062 | −0.004 | 0.131 | - | No |
| EE→CU | 0.249 | 0.159 | 0.338 | - | Yes |
| Standardized direct effects | | | | | |
| INT→PE | 0.288 | 0.138 | 0.442 | 0.525 | |
| INT→EFE | 0.429 | 0.269 | 0.583 | 0.563 | |
| INT→SI | 0.228 | 0.121 | 0.347 | 0.534 | |
| INT→HA | 0.345 | 0.191 | 0.494 | 0.277 | |
| IMM→PE | 0.166 | 0.017 | 0.331 | - | |
| IMM→EFE | 0.043 | −0.093 | 0.186 | - | |
| IMM→SI | 0.139 | 0.014 | 0.266 | - | |
| IMM→HA | −0.015 | −0.162 | 0.143 | - | |
| TE→PE | 0.364 | 0.179 | 0.528 | - | |
| TE→EFE | 0.359 | 0.196 | 0.529 | - | |
| TE→SI | 0.446 | 0.283 | 0.588 | - | |
| TE→HA | 0.242 | 0.060 | 0.413 | - | |
| PE→BI | 0.207 | 0.059 | 0.359 | 0.720 | |
| EFE→BI | 0.297 | 0.153 | 0.435 | - | |
| SI→BI | 0.329 | 0.193 | 0.450 | - | |
| HA→BI | 0.132 | 0.042 | 0.231 | - | |
| BI→CU | 0.684 | 0.600 | 0.754 | - | |
| Standardized indirect effects | | | | | |
| INT→PE→BI→CU | 0.040 | 0.011 | 0.090 | - | Yes |
| INT→EFE→BI→CU | 0.087 | 0.041 | 0.141 | - | Yes |
| INT→SI→BI→CU | 0.050 | 0.021 | 0.092 | - | Yes |
| INT→HA→BI→CU | 0.030 | 0.008 | 0.066 | - | Yes |
| IMM→PE→BI→CU | 0.022 | 0.001 | 0.067 | - | Yes |
| IMM→EFE→BI→CU | 0.008 | −0.018 | 0.040 | - | No |
| IMM→SI→BI→CU | 0.030 | 0.004 | 0.069 | - | Yes |
| IMM→HA→BI→CU | −0.002 | −0.017 | 0.013 | - | No |
| TE→PE→BI→CU | 0.051 | 0.014 | 0.106 | - | Yes |
| TE→EFE→BI→CU | 0.072 | 0.029 | 0.139 | - | Yes |
| TE→SI→BI→CU | 0.100 | 0.053 | 0.161 | - | Yes |
| TE→HA→BI→CU | 0.020 | 0.004 | 0.053 | - | Yes |

INT: Interactivity , IMM: Immersivity, TE: Technology embodiment, PE: Performance expectancy, EFE: Effort expectancy, SI: Social influence, HA: Hedonic adaptation, BI: Behavioural intention, CU: Continued usage. (Source: Authors' own research)

**Table 9: Multi-group analysis according to "Previous AR Experience"**

| Hypotheses | Path name | Path coefficients-diff (Previous AR use Yes-No) | P-value (Previous AR use Yes vs. No) |
|---|---|---|---|
| $H_{1a}$ | Interactivity→Performance Expectancy | 0.057 | 0.758 |
| $H_{1b}$ | Interactivity→Effort Expectancy | 0.079 | **0.635** |
| $H_{1c}$ | Interactivity→Social Influence | −0.043 | **0.705** |
| $H_{1d}$ | Interactivity→Hedonic adaptation | −0.015 | **0.941** |
| $H_{2a}$ | Immersivity→Performance Expectancy | −0.114 | **0.523** |
| $H_{2b}$ | Immersivity→Effort Expectancy | −0.314 | **0.035*** |
| $H_{2c}$ | Immersivity→Social Influence | −0.121 | **0.408** |
| $H_{2d}$ | Immersivity→Hedonic adaptation | 0.004 | **0.980** |
| $H_{3a}$ | Technology embodiment→Performance Expectancy | −0.063 | **0.752** |
| $H_{3b}$ | Technology embodiment→Effort Expectancy | 0.107 | **0.595** |
| $H_{3c}$ | Technology embodiment→Social Influence | 0.083 | **0.606** |
| $H_{3d}$ | Technology embodiment→Hedonic adaptation | −0.022 | **0.915** |
| $H_4$ | Performance Expectancy→Behavioural Intention | −0.325 | **0.029*** |
| $H_5$ | Effort Expectancy→Behavioural Intention | 0.197 | **0.208** |
| $H_6$ | Social Influence→Behavioural Intention | 0.049 | **0.689** |
| $H_7$ | Hedonic adaptation→Behavioural Intention | 0.131 | **0.205** |
| $H_8$ | Behavioural Intention→Continued Usage | 0.015 | **0.810** |

***P<0.001, **P<0.01, *P<0.05. Bold values indicate statistically significant between-group differences for that path (see p-value column). (Source: Authors' own research)

= 0.362, t = 4.067; $H_{3a}$ confirmed), effort expectancy (β = 0.358, t = 4.262; $H_{3b}$ confirmed), social influence (β = 0.445, t = 5.705; $H_{3c}$ confirmed), and hedonic adaptation (β = 0.241, t = 2.770; $H_{3d}$ confirmed). Furthermore, all UTAUT2-derived constructs performance expectancy (β = 0.207, t = 2.760; $H_4$ confirmed), effort expectancy (β = 0.297, t = 4.183; $H_5$ confirmed), social influence (β = 0.329, t = 5.062; $H_6$ confirmed), and hedonic adaptation (β = 0.132, t = 2.809; $H_7$ confirmed)—significantly predicted behavioural intention. These results validate the applicability of UTAUT2 in explaining behavioural intention toward AR gaming. Finally, behavioural intention strongly influenced continued usage (β = 0.685, t = 17.125; $H_8$ confirmed), underscoring its role in sustaining engagement with AR technologies. The outcomes of hypothesis testing are consolidated in Table 6.

All constructs demonstrated high internal consistency, with Cronbach's α exceeding 0.879 (Table 2). Mean scores ranged from 3.29 (Hedonic Adaptation) to 4.71 (Social Influence) on a 7-point scale, indicating generally positive perceptions of AR gaming features.

#### *5.5.1. Mediating effect*

Structural equation modeling was conducted to evaluate how UTAUT2 constructs and behavioural intention mediated the relationship with continued use of the ARbased game (Qin et al., 2021). Using a bootstrapbased path analysis (Table 7) (Preacher and Hayes, 2004), we tested both direct and indirect effects. All hypothesized mediating paths proved significant except for IMM → PE → BI → CU, IMM → SI → BI → CU, and EE → HA → BI → CU, whose indirect effects failed to achieve statistical significance by P-value. However, the 95% bootstrap confidence intervals for these three paths did not include zero, indicating that mediation nevertheless holds at the 95% confidence level (Cepeda-Carrion et al., n.d.; Preacher and Hayes, 2008) (Table 8).

The model explains 72.0% of variance in Behavioural Intention ($R^2$ = 0.720), indicating strong predictive power consistent with prior UTAUT2 studies (Venkatesh et al., 2012).

##### 5.5.1.1. Multi-group analysis

In assessing whether previous AR exposure influenced the model estimates, we performed a multi-group analysis as described in (Henseler et al., 2009; Sarstedt et al., 2011). The results presented in Table 7 show that immersivity → effort expectancy and performance expectancy → behavioural intention were two paths that were significantly stronger among participants with no prior AR experience. This is consistent with a novelty effect of AR gaming relative to mobile gaming and reflects typical consumer behaviour for new-technology products. No other structural paths had meaningful differences between experience groups.

## 6. CONCLUSION

The results of the study provide strong theoretical support for the majority of its hypotheses and also reasoned justification for the construct of extending UTAUT2 with two AR-specific extensions; interactivity and technological embodiment served as significant antecedents in all expectancy and hedonic pathways (supporting $H_1$ and $H_3$), while immersivity exhibited a more narrow pattern of significance value relative to performance expectancy and social influence as a mechanism, while not supporting all hypothesized behavioural path values ($H_2$ was only partially supported) as it seems to serve mainly to increase the perceived value of usefulness and social visibility, rather than a measure to decrease cognitive effort or battery power. Nevertheless, core UTAUT2 impact behavioural predictors (e.g., performance expectancy, effort expectancy, and social influence) and hedonic adaptation (HA) predicted behavioural intention significantly and then intention predicted continued use behavioural strongly (β ≈ 0.69), while the structural model accounts for about 72% of variance of continued use ($R^2$ ≈ 0.72). Taken together, the study's empirical results support that durable engagement in mobile AR is largely dependent on interactive affordances, usability, aspects of embodied interface characteristics and aspects which refresh hedonic value rather than mostly a one-off novelty experience

### 6.1. Theoretical Implication

This study has a significant contribution to the unified Theory of Acceptance and Use of Technology (UTAUT2) as it extend the theory by adding various AR factors (Interactivity, Immersivity, Technology embodiment) that affects continuous usage of the AR application. Interactivity and augmentation are essential attributes that enhance effort expectancy, hence promoting the continued usage of the application. Immersive sensory elements provide a compelling virtual presence that increases engagement. Technology embodiment amplifies social influence by integrating tangible cues that reinforce consumer perceptions about AR. Behavioural intention is a crucial driver for continuous app usage, as a strong commitment to engage with the app's features which directly translates into sustained and repeated use. The integration of the UTAUT2 theory and its extensions with constructs will explain the influence of behavioural intention impact on continuous usage of the application. The generalisability of the model is already tested in other studies.

### 6.2. Practical Implication

This study has various practical implication. First for the creators of the AR apps, these findings offer significant and valuable implications for future development of AR based apps. AR attributes such as Interactivity, Immersivity and Technology embodiment of AR deepens user engagement and affects technology significantly. Secondly, as Immersivity has a positive impact on performance expectancy and social influence but a negative impact on effort expectancy and hedonic adaptation. Creators of AR application should specially focus more on performance expectancy and social influence as it will increase the behaviour intention of the user. Thirdly, Interactivity has less positive impact on performance expectancy. App designer must prioritise the enhancement of these ar properties to cultivate a favourable user experience. Hence AR attributes should be focus more on creating a balanced environment and impacting overall behavioural intention of the user.

Developer of gamified augmented reality applications can also use the AR social influence as a key to bring new users who are more inclined to use the application, one aspect which needs to be looked is hedonic adaptation which leads to distraction of some users which impact their behaviour. Inadequate system performance, evident in delays and visual interruptions, hinders sustained engagement with AR, highlighting the necessity for improved reliability to prevent user discontinuance towards AR (Sun et al., 2022) and this may create drawback for users to use AR features. Optimizing facial feature detection and ensuring smooth expressions allows AR developers to deliver a more realistic and captivating experience, thereby increasing user engagement. Subsequently Technology embodiment influences social influence and effort expectancy, both have positive effect on user behavioural intention, we found that AR attributes Technology embodiment will increase adaptation hence increase in overall continuous usage of the application. AR app creators should prioritize enhancing interactivity demonstrate that robust interactive features can significantly reduce technology anxiety and drive continuous usage (Hung et al., 2021). The application of AR is important in the field of gaming. It can also be seen from MGA analysis, indication towards previous AR experience showing moderating effect. Towards the usage of the application affect the behavioural intention towards the app hence affecting continuous usage of the app. Which help company reach towards consumer market.

### 6.3. Limitations

There are some limitations to the present study.

1. The study considers general population those have AR application but further study can focus on specific set of population to have clear understanding of the population mindset
2. Qualitative study also needs to be taken for the further consideration that ensures view of the population about the AR technology
3. The need for longitudinal study which focuses on the long-term adaptation of the AR application used in their day-to-day life and long-term study will provide a better result.

### 6.4. Future Scope

The future studies should focus on continuous usage of the AR application benefit companies by making money as AR increases the cost of the app development to cover this cost in long term tested research needs to be done to make money for the company in long run to sustain the overall cost. The next phase of research should focus on adding variables such as personality traits and device specific variables (embodiment effects). The future studies should focus on the condition of continuous behaviour translating into actual behaviour is the overall behaviour of the user changing. Another aspect of the research should focus on the movements of the facial expression (eyes, eyebrows) this will test the user attention towards details and placement of the product in the AR. The future studies should also draw a comparison between AR apps experience and in store AR experience of the products. A comparative study can also be conducted based on new adopters towards AR and experienced user and their attention span and continuous usage can also be monitored this will help companies prepare separate strategies to tackle the users in their own manner. Marketing gimmick techniques towards AR can also be used in order to attract new users towards AR.

## REFERENCES

Bagozzi, R.P., Yi, Y. (1988), On the evaluation of structural equation models. Journal of the Academy of Marketing Science, 16(1), 74-94.

Balakrishnan, J., Dwivedi, Y.K., Mishra, A., Malik, F.T., Giannakis, M. (2024), The role of embodiment and ergonomics in immersive VR tours in creating memorable tourism experiences. International Journal of Contemporary Hospitality Management, 36, 3794-3822.

Çalışkan, G., Yayla, İ., Pamukçu, H. (2023), The use of augmented reality technologies in tourism businesses from the perspective of UTAUT2. European Journal of Innovation Management, 28, 1498-1526.

Cepeda-Carrion, G.A., Roldán, J.L., Cepeda, G., Nitzl, C. (n.d.), Mediation Analyses in Partial Least Squares Structural Equation Modeling. Guidelines and Empirical Examples. Available from: https://www.researchgate.net/publication/315696810

Fan, X., Jiang, X., Deng, N. (2022), Immersive technology: A metaanalysis of augmented/virtual reality applications and their impact on tourism experience. Tourism Management, 91), 104534.

Faqih, K.M.S., Jaradat, M.I.R.M. (2021), Integrating TTF and UTAUT2 theories to investigate the adoption of augmented reality technology in education: Perspective from a developing country. Technology in Society, 67, 101787.

Fornell, C., Larcker, D. F. (1981), Structural equation models with unobservable variables and measurement error: Algebra and statistics. Journal of Marketing Research, 18(3), 382–388.

Genay, A., Lecuyer, A., Hachet, M. (2022), Being an avatar "for real": A survey on virtual embodiment in augmented reality. IEEE Transactions on Visualization and Computer Graphics, 28(12), 5071-5090.

Hair, J.F., Hult, G.T.M., Ringle, C.M., Sarstedt, M. (2017), A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM). London: Sage.

Hair, J.F., Ringle, C.M., Sarstedt, M. (2011). PLS-SEM: Indeed a Silver Bullet. Journal of Marketing Theory and Practice, 19(2), 139-152.

Hair, J.F., Sarstedt, M., Ringle, C.M., Mena, J.A. (2012), An assessment of the use of partial least squares structural equation modeling in marketing research. Journal of the Academy of Marketing Science, 40(3), 414-433.

Henseler, J., Ringle, C.M., Sinkovics, R.R. (2009), The Use of Partial Least Squares Path Modeling in International Marketing. England: Emerald Group Publishing. p.277-319.

Hilken, T., de Ruyter, K., Chylinski, M., Mahr, D., Keeling, D.I. (2017), Augmenting the eye of the beholder: Exploring the strategic potential of augmented reality to enhance online service experiences. Journal of the Academy of Marketing Science, 45(6), 884-905.

Hsu, S.H.Y., Tsou, H.T., Chen, J.S. (2021), "Yes, we do. Why not use augmented reality?" Customer responses to experiential presentations of AR-based applications. Journal of Retailing and Consumer Services, 62, 102649.

Hu, L., Bentler, P.M. (1999), Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Structural Equation Modeling: A Multidisciplinary Journal, 6(1), 1-55.

Hung, S.W., Chang, C.W., Ma, Y.C. (2021), A new reality: Exploring continuance intention to use mobile augmented reality for entertainment purposes. Technology in Society, 67, 101757.

Ibáñez-Sánchez, S., Orús, C., Flavián, C. (2022), Augmented reality filters on social media. Analyzing the drivers of playability based on uses and gratifications theory. Psychology and Marketing, 39(3), 559-578.

Jessen, A., Hilken, T., Chylinski, M., Mahr, D., Heller, J., Keeling, D.I., de Ruyter, K. (2020), The playground effect: How augmented reality drives creative customer engagement. Journal of Business Research, 116, 85-98.

Kapoor, A., Sindwani, R., Goel, M. (2023), Exploring quick commerce service experience: a moderated mediated investigation using SEM and fsQCA. Total Quality Management and Business Excellence, 34(13–14), 1896-1919.

Khan, I., Fatma, M. (2024), AR app-based brand engagement and outcomes: A moderated mediation approach. Journal of Retailing and Consumer Services, 76, 103618.

Kim, H.S. (2016), What drives you to check in on Facebook? Motivations, privacy concerns, and mobile phone involvement for location-based information sharing. Computers in Human Behavior, 54, 397-406.

Kim, M.J., Lee, C.K., Jung, T. (2020), Exploring consumer behavior in virtual reality tourism using an extended stimulus-organism-response model. Journal of Travel Research, 59(1), 69-89.

Koutromanos, G., Kazakou, G. (2023), Augmented reality smart glasses use and acceptance: A literature review. Computers and Education: X Reality, 2, 100028.

Kumar, H. (2022), Augmented reality in online retailing: A systematic review and research agenda. International Journal of Retail and Distribution Management, 50(4), 537-559.

Lavoye, V., Tarkiainen, A., Sipilä, J., Mero, J. (2023), More than skin-deep: The influence of presence dimensions on purchase intentions in augmented reality shopping. Journal of Business Research, 169, 114247.

Lee, H., Xu, Y., Porterfield, A. (2021), Consumers' adoption of AR-based virtual fitting rooms: from the perspective of theory of interactive media effects. Journal of Fashion Marketing and Management, 25(1), 45-62.

Nikhashemi, S.R., Knight, H.H., Nusair, K., Liat, C.B. (2021), Augmented reality in smart retailing: A (n) (A) Symmetric Approach to continuous intention to use retail brands' mobile AR apps. Journal of Retailing and Consumer Services, 60, 102464.

Pallavicini, F., Pepe, A., Minissi, M.E. (2019), Gaming in virtual reality: What changes in terms of usability, emotional response and sense of presence compared to non-immersive video games? Simulation and Gaming, 50(2), 136-159.

Pannucci, C.J., Wilkins, E.G. (2010), Identifying and avoiding bias in research. Plastic and Reconstructive Surgery, 126(2), 619-625.

Pathak, K., Prakash, G. (2023), Exploring the role of augmented reality in purchase intention: Through flow and immersive experience. Technological Forecasting and Social Change, 196, 122833.

Pinto, A.S., Abreu, A., Costa, E., Paiva, J. (2022), Augmented reality for a new reality: Using UTAUT-3 to assess the adoption of mobile augmented reality in tourism (MART). Journal of Information Systems Engineering and Management, 7(2), 12012.

Preacher, K.J., Hayes, A.F. (2004), SPSS and SAS procedures for estimating indirect effects in simple mediation models. Behavior Research Methods, Instruments, and Computers, 36(4), 717-731.

Preacher, K.J., Hayes, A.F. (2008), Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40(3), 879-891.

Qin, H., Osatuyi, B., Xu, L. (2021), How mobile augmented reality applications affect continuous use and purchase intentions: A cognition-affect-conation perspective. Journal of Retailing and Consumer Services, 63, 102680.

Qin, H., Peak, D.A., Prybutok, V. (2021), A virtual market in your pocket: How does mobile augmented reality (MAR) influence consumer decision making? Journal of Retailing and Consumer Services, 58, 102337.

Rau, P.L.P., Zheng, J., Guo, Z. (2021), Immersive reading in virtual and augmented reality environment. Information and Learning Science, 122(7-8), 464-479.

Rauschnabel, P.A., Felix, R., Hinsch, C. (2019), Augmented reality marketing: How mobile AR-apps can improve brands through inspiration. Journal of Retailing and Consumer Services, 49, 43-53.

Rizkalla, N., Tannady, H., Bernando, R. (2023), Analysis of the influence of performance expectancy, effort expectancy, social influence, and attitude toward behavior on intention to adopt live on. Multidisciplinary Reviews, 6(Special Issue), 017.

Saleem, M., Kamarudin, S., Shoaib, H.M., Nasar, A. (2022), Retail consumers' behavioral intention to use augmented reality mobile apps in Pakistan. Journal of Internet Commerce, 21(4), 497-525.

Sarstedt, M., Henseler, J., Ringle, C.M. (2011), Multigroup analysis in partial least Squares (PLS) Path Modeling: Alternative Methods and Empirical Results. England: Emerald Group Publishing Ltd., p195-218.

Schultz, C.D., Kumar, H. (2024), ARvolution: Decoding consumer motivation and value dimensions in augmented reality. Journal of Retailing and Consumer Services, 78, 103701.

Shin, D. (2019), How does immersion work in augmented reality games? A user-centric view of immersion and engagement. Information Communication and Society, 22(9), 1212-1229.

Sun, C., Fang, Y., Kong, M., Chen, X., Liu, Y. (2022), Influence of augmented reality product display on consumers' product attitudes: A product uncertainty reduction perspective. Journal of Retailing and Consumer Services, 64, 102828.

Szekely, R., Mason, O., Frohlich, D.M., Barley, E.A. (2024), Acceptability, feasibility, and preliminary evaluation of an animated VR game for reducing mental health stigma in health-care students and trainees: a mixed-method study. Mental Health and Digital Technologies. https://doi.org/10.1108/mhdt-03-2024-0010

Tenenhaus, M., Vinzi, V.E., Chatelin, Y.M., Lauro, C. (2005), PLS path modeling. Computational Statistics and Data Analysis, 48(1), 159-205.

Tussyadiah, I.P., Jung, T.H., Tom Dieck, M.C. (2018), Embodiment of wearable augmented reality technology in tourism experiences. Journal of Travel Research, 57(5), 597-611.

Ustun, A.B., Karaoglan-Yilmaz, F.G., Yilmaz, R., Ceylan, M., Uzun, O. (2024), Development of UTAUT-based augmented reality acceptance scale: A validity and reliability study. Education and Information Technologies, 29(9), 11533-11554.

Venkatesh, M., Davis, D. (2003), User acceptance of information technology: Toward a unified view. MIS Quarterly, 27(3), 425.

Venkatesh, T., Thong, J.Y.L., Xu, X. (2012), Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. MIS Quarterly, 36(1), 157.

Vidal-Silva, C., Sánchez-Ortiz, A., Serrano-Malebrán, J., Arriagada, V., Flores, M., Godoy, M., Vargas, C. (2024), Social influence, performance expectancy, and price value as determinants of telemedicine services acceptance in Chile. Heliyon, 10(5), e27067.

Yim, M.Y.C., Chu, S.C., Sauer, P.L. (2017), Is augmented reality technology an effective tool for E-commerce? An interactivity and vividness perspective. Journal of Interactive Marketing, 39, 89-103.

Zheng, S., Li, D. (2023), The dark side of AR usage on customers' online purchase. Nankai Business Review International, 14(1), 128-160.