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Effects of User Experience on Immersion and Intention to Play Augmented Reality Games

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Abstract. Augmented reality (AR) mobile gaming saw massive popularity following Pokémon Go. However, many later entrant AR games have struggled with declining user retention over time. This study examines how certain user experience factors relate to immersion while playing AR games, and downstream impacts on intention to continue playing. An online survey was conducted with 214 experienced AR gamers. Results showed brand experience and user need fulfillment experience positively predicted immersion. Greater immersion subsequently showed positive effects on user confirmation, satisfaction, and ultimately intention to continue playing AR games. The findings provide developers useful guidance on elements of the user experience to focus on improving immersion and retention in this burgeoning category of mobile entertainment.

Keywords: Augmented Reality, Game, Immersion, User Experience

1. Introduction

Everyone in the world has ever encountered playing games at least once in their lives. Games were designed to make people feel enjoyment and fun. The purpose of games is to entertain the player by providing a goal and missions (Stenros, 2017). Games also were played not only for man, but for all genders. Since the phenomenon of Pokémon Go back then in 2016, the world has been introduced world widely about Augmented Reality (AR) games.

After Pokémon Go, many developers are trying to develop similar games that utilize the AR technology. AR technology itself has an impressive potential to be applied in the gaming industry. The market also shows a strong leaning towards mobile gaming. According to Newzoo report, they emphasize that mobile gaming generated $93.2B in 2021. This astounding number indicates that AR gaming could be in the part to take the revenue in the future.

Augmented reality technology has revolutionized the gaming industry by merging the real and virtual worlds and providing users with an immersive gaming experience. Augmented reality games have gained increasing popularity in recent years due to their ability to create interactive and engaging gameplays that require players to move around and interact with the physical environment. This unique gaming experience has attracted both casual and serious gamers, and many game developers are investing in AR technology to create innovative games that offer a new level of immersion.

Despite the initial hype surrounding AR gaming, there is an issue that is going on in the market of AR games that not many people are aware of. The issue comes from where currently many AR games in the market are struggling to survive, and some of it led to shut down. Niantic Lab, the company that developed Pokémon Go, also shut down several of their products for such as, NBA All World, Marvel World of Heroes, and Harry Potter Wizards Unite. The reason behind it was the game was too mediocre, and not much user interest to play that game that makes the expenses of the company are much more than the revenue.

There are several barriers that holding users on intent to play AR games. One of them is privacy concerns that might leak the personal information of the user, or the data will be misused. And there are technology characteristics, emotional stimuli, and innovativeness that motivate on adopting AR games (Faqih, 2022). And as written in the literature, privacy is one of the user experiences on using a product. And according to some expert reviews and users' perspective on Quora, one of the problems that the users felt about the current AR games that the developers to keep and produced a better way are the user experiences. The consistency of the experiences of playing the AR game needs to be adjusted. The user experience quality is also one of the problems that needs to be improved to maintain the user interest.

One of the key factors that drives people enjoy video game is immersion (Nilsen et al., 2014; D. Shin, 2019). This immersion could be reached if the user experience meets the user requirements (D. Shin, 2019). The immersion could be perfectly done by the support of combining technology AR and VR. User experience defines the experience of the user while using the technological product or service. It is recognized as a concept that combines subjective perspectives with universal applicability. User experiences has been acknowledged as one of the significant quality factors of interactive product and service (Irshad & Rambli, 2015).

AR and other immersive media offer affordances of presence, immediacy, and immersion. The overlay of graphics and objects that generated by AR pushes and drives the user to feel the presence of the game with real time. The user needs to act accordingly to the feedback and immediacy. Both user experiences lead to the immersion, where the user feels the mediated space and looking at the objects while interacting and giving feedbacks to it (Wu et al., 2013). Hence, the AR technology primarily offers a different user experience while using it. Because the purpose of AR is to give the immersion feelings for user.

Facts about AR gaming in last decades:

- Developers of AR use ARKit mostly for developing games ARKit is Apple's augmented reality (AR) platform for iOS devices (Sensortower, 2018)
- The total number of Pokémon Go downloads has exceeded 1 billion. (Statista, Business of Apps). This shows that there is a market for AR games.
- Augmented Reality Gaming Market size was valued at USD 4.5 Billion in 2020
- 36% of game developers develop games for select AR/VR platforms (Statista). This shows that there are developers that are interested on the AR games market.
- Big company that produces and develops AR games: Zappar, Augmented Reality Labs., Microsoft, Niantic, Tencent, NetEase, Magic Leap, Lucyd, Supercell, Nordau Creative, Eyes on AR, Appl.
- Approximately 1 billion consumers worldwide are using augmented reality in 2020 (Threekit)
- Investments in AR technology are growing, and $18.8 billion was invested in AR in 2020 (Threekit)

Behind all these beautiful numbers and statistics, there were bunch of augmented reality games that have failed due to lack of interest user and technical updates that didn't buck up the user. List of famous augmented reality games that have been shut down:

- Jurassic World Alive: Developed by Ludia, this AR game allowed players to collect dinosaurs in the real world. Despite initial popularity, the game's player base dwindled, and it was eventually shut down in 2022.
- Harry Potter: Wizards Unite: Another game by Niantic, this AR game was based on the Harry Potter universe. Despite initial excitement, it failed to maintain a large player base, and updates ceased in 2021. The game's servers were shut down on January 31, 2022.
- Ghostbusters World: Released in 2018, this AR game allowed players to catch ghosts similar to Pokémon Go. However, due to a lack of player interest and support, the game was shut down in 2020.
- Minecraft Earth: Developed by Mojang Studios, Minecraft Earth allowed players to build structures in the real-world using AR. Despite initial excitement, it failed to maintain a large player base and was shut down in June 2021.
- NBA All World: Develop by Niantic, released on January 24 2023 - Shutdown on 22 September 2023. A game that enables users to compete in basketball game of NBA. closed due to expenses growing more than the revenue of the company. Revenue didn't generate enough because lack of interest and growth user in the game.
- Marvel World of Heroes: Develop by Niantic, released on April 17 2023 - Shutdown on July 14 2023. Reasons for shut down are similar to NBA All World.
- Night Terrors: Marketed as "the world's first augmented reality survival horror game," Night Terrors used AR to turn players' surroundings into a terrifying environment filled with ghosts and other supernatural entities. Despite initial excitement, the game was discontinued around 2018 due to technical challenges and lack of funding.

After the Pokémon GO phenomenon in 2016, there is no single game of AR that have been successful as Pokémon Go. The technology AR is close to the words of immersion, because that was the technology offers to the user. As have been mentioned above, immersion is one of the key factors that drive peoples to enjoy video games. Immersion is also one of the important factors of a player experience (Christou, 2014).

The aim of this study is to search what aspect of user experience could affect immersion on the augmented reality games and will led to intention of playing the AR games. Based on previous research from (D. Shin, 2019), immersion is the starting point of user that might flows and end up to intention. And this immersion is influenced or afforded by Brand Experience, Technology Experience, and User Need Experience(D. Shin, 2019; Xu et al., 2022; Zeng et al., 2023). Alongside of that (Zarour & Alharbi,

2017) proposed the same user experience framework that consist of those 3 experiences and will be carried out in this research.

This paper's purpose of research is to imply the dimensions of UX that have correlation with the immersion of AR in gaming. And to give novelty about the immersion that will led to intention to play for the AR gaming industry in generally and does not specifically pointed to one game. So in the future, researchers and developers could create and develop a good augmented reality games that will successfully survive in the market.

2. Literature Review

2.1. Augmented Reality

Augmented Reality (AR) is a variation of the mixed reality that proposed by (Milgram & Kishino, 1994). He proposed an idea of virtuality continuum origins see figure 2.1 , they describe where the AR comes from for better understanding. They sought to defining four types of environments that we know. At the end of left are the one we familiar with, real environment where we all live. And at the opposite end there is a virtual environment, where everything is generated by computer technology. Between these two there are Augmented Reality (AR) where the real environment is enhanced or mixed with computer generated, as for Augmented Virtuality (AV) where the virtual world is enhanced or mixed with the real-world objects.

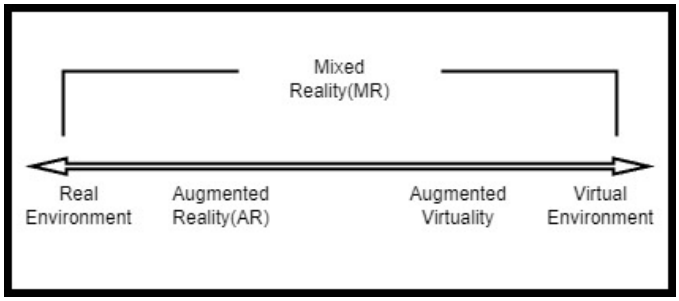

Fig.1: Virtuality continuum of Milgram (Milgram & Kishino, 1994)

AR is closely similar to virtual reality (VR) as where the concept of AR is born and evolved within VR (Yuen et al., 2011). AR is closer to the real world if compared to AV because AR background is from real world where AV background is from computer generated. Virtual Environments have all the environments and objects from the computer enhancement which make is more unreal. In the future when technologies running more advanced, where real world and virtual world spacing is more likely to mixed it will be difficult to tell apart (Yuen et al., 2011).

To make it more better understanding, (Azuma, 1997) implied 3 characteristics of AR. First is that AR combines real and virtual objects, then the objects that are generated are interactive in real time. Lastly, all these objects that could be seen have 3D graphics. And to access the AR environment, people need to have the devices that can support the technology. Some of the devices are head-mounted display, high-tech googles, and even for now there are smartphones.

Generally, there are 2 types of AR, location-based and image-based, these 2 types help us to understand which one is suitable for and how it works. These 2 AR types are both giving experiences where AR give 3D perception inside the real world to its user. To display these AR objects it needs mobile devices, head-mounted display, or projection screens. AR technologies has helped improving various fields such as engineering, medical, education, entertainment, etc. because AR give user experiences where in the world could not provide (Ozdemir et al., 2018).

2.2. Augmented Reality Games

The first augmented reality gaming is AR Quake and was developed by (Thomas et al., 2000) on the year of 2000. It was the extension and advanced desktop game of Quake. The game is a first-person perspective application which using GPS, a digital compass and vision-based tracking of fiducial markers. At that time, user need to wear a backpack which carry the computer or so called the wearable computer to process the game, then a head-mounted display for the user to view the game, and there are 2 buttons for user to interact at the game. So, it was something really complicated at that time to play augmented reality gaming due to the technology is still conventional. AR games show a live video of the real world through a camera, and on top of that, they add virtual things like computer-made images. (D. Shin, 2019).

After the AR quake, (Cheok et al., 2003) developed a new mobile augmented reality games that are better than AR quake. It still used wearable computer, but not as big as the one that used on AR quake. The game was Human Pacman, is built upon position and perspective sensing via GPS and inertia sensors. The Pacman and ghosts are now real human that used the wearable computer that are equipped with GPS too. The game mechanics are changing unlike before, it was more fun because the humans now are also moving on the game.

Since then, the development of augmented reality has grown year after year. More technology and features were implemented on the technology (Arth et al., 2015) The technology of augmented reality is being used in various kinds of field, there were advertising and marketing, architecture and construction, entertainment, medical, military, and travel (Yuen et al., 2011).

Suddenly, on 2016 Niantic company released an AR game named Pokémon Go. Niantic is a software development company that was founded in 2010 and is based in San Francisco, California. The company is best known for creating augmented reality (AR) mobile games. It was really booming because of the unique gameplay. The player can catch various kinds of Pokémon's by traveling around and open their camera from the app that will show them the Pokémon's. At that year, the active user of Pokémon go reach 232 million users according to Business of Apps. Almost every Pokémon fans in the world have tried to play this game. Within a month period since the released date, the game was available for 56 countries. But the revenue of Pokémon Go, increase if we look from 2016 and 2021. In 2016 the revenue was $0.83 billion and in 2021 the revenue was $1.21 billion. The daily active user may decrease, but the revenue still going up. 2016 was the peak of user until now. They haven't reached those numerous daily active users since then.

As one of the lead companies of AR mobile games, Niantic continues to build and develop AR mobile games. In 2018 they launched Ingress Prime, and for 2019 they launched Harry Potter: Wizards Unite. Currently the game of Harry Potter: Wizards Unite has been shut down in January 2022, because not many players seek to play that game. The CEO of Niantic, John Hanke said that the reason of the shutdown is the game was mediocre. But the company does not stop after the closure of Harry Potter: Wizards Unite, right now they are in the middle of developing NBA AR game and there is also coming up about Marvel game, and AR pet game too.

This is just one insight from Niantic, there are others companies that also running in the development of augmented reality technology out there. The future of augmented reality is bright, primarily the games. Because most of the technology of AR right now is being used for games.

2.3. Immersion

A good game must have the ability to draw people in. one of the elements that could draw people in is immersion. Immersion is also one of the important factors of a player's experience (Christou, 2014). Presence is defined by (Cheok et al., 2003) ''as the subjective experience of being in one place or environment, even when one is physically situated in another''. Immersion involves the sensation of an entirely different surroundings and environment of an individual (Arth et al., 2015). The level of presence experienced by virtual environments is defined by certain characteristics of the participant, and they named these characteristics as immersive tendency. Immersion is the term that being used to

discuss the same feeling as that presence, but only in the field of video games (Olsson et al., 2013). (Minge & Thüring, 2018) also defined immersion as enhanced of "being there" which is identical to the presence definition by (Olsson et al., 2013).

Immersion in video games means that the players is caught into the world of the games story and the player's love of the game (Olsson et al., 2013). (Souza et al., 2022) implies that immersion has three unique characteristics, there are, lack of awareness of time, loss of awareness of the real world, and involvement and a sense of being in the task environment. Playing video games is all about getting lost in the many different and interesting worlds they create (Nilsen et al., 2014). As technology is getting better and better, video games and supporting technology have appeared to approach complete immersion. With augmented reality enters the game industry, immersion is becoming the major attraction point for the user to play and enjoy the augmented reality games (Nilsen et al., 2014). The term on immersion in gaming context means the realism of the game world (Arth et al., 2015).

The primary reason people play AR games is the pleasure and experience of being immersed and mediated to the virtual world (Kallioniemi et al., 2017). (Lugrin et al., 2013) propose an idea of immersion of video games, there are three pleasures of gameplay. The first is audiovisuality, that consists of graphics, sounds, novelty, and music. The second is challenges, that consist of solving, winning, controlling, and creating. And the last one is fantasy, that consists of world, characters, exploration, and theme.

2.4. User Experience and Immersion

According to ISO 9241-210, user experience is defined as "A person's perceptions and responses that result from the use or anticipated use of a product, system or service". User experience is about how people interact with a product. It's not just about making it easy to use but also creating a connection that feels good emotionally (Olsson et al., 2013).

The perspective of user to the product usage is changing after and during using the product, this make user experience a dynamic concept (Minge & Thüring, 2018). UX can also be viewed as an elaboration of satisfaction that one of the components of usability (Zarour & Alharbi, 2017). But there is also another opinion that usability could be measured by objective measurement and user experience is measured by subjective measurement. And (Zarour & Alharbi, 2017) has proposed some aspects of user experience and grouped them by each of the dimension. There are Brand Experience (BX), User Needs Experience (NX), and Technology Experience (TX). The purpose of grouped by three dimension is to make it easy to measure and calculate the user experience on respondents. The framework also has been used in another recent research regarding the user experience too by (Souza et al., 2022).

- Brand Experience (BX) is everything related that focused to brand organization image. For example, the company marketing how, it sells the product.
- Technology Experience (TX) is everything related focused on the technology that has been used to provide the product or the service. This dimension represents something like the infrastructure of the product, could be the service response time too.
- User Needs Experience (NX) is everything related to focused user needs and gained qualities. For this dimension, it discussed about how the user feel fun, sensual, emotional, and others.(Zarour & Alharbi, 2017)

As immersion became a key of user experience and gainly became unique. User experience is an important aspect when it comes to interactive products and services. (Irshad & Rambli, 2015). From the research of (D. Shin, 2019), it proves that immersion is one of the keys for a good user experience of augmented reality gaming. In order to create successful and engaging products, user experience should be taken seriously in the early stages of development by researching potential users' expectations (Olsson et al., 2013)

(Ghazwani & Smith, 2020) defined that there are 3 principles components of interaction in AR System: the user, the user interface, and the virtual content. Thus, there are several challenges that exists around AR technology when it comes to user experience. From the virtual content challenges are the network and security, AR online games require fast network to prevent lag and delays, then security measures are needed to keep track of and control what users can see. As for the user interface challenges are the lack of physical feedback from the 3D objects, limited adjustable view objects, and limited interaction. These challenges could hold back the immersion feeling of user when they are reaching and playing the game for a long time.

2.5. Previous Works

In this section, we provide an explanation of the topics discussed earlier in the paper and describe the variables used in the research. In the previous research, it determined that immersion is important on adopting augmented reality games (D. Shin, 2019)

previous study from (Kallioniemi et al., 2017) also mentioned and researched about the user experience and immersion on omnidirectional video and head mounted display. This research studied how users experience the immersive experience from the device that might give them a view of 3D objects on the real world. And as a result, both indoors and outdoors, user could feel the immersive experience. It does not matter if the user is using the device indoors or outdoors. They will still experience the immersive experience.

(Lugrin et al., 2013) a study about immersive on FPS games, where the target is using CAVE system and play the game through the system to analyze the user experience and preferences. To measure the user experience, it used 3 main categories, which are in-game performance, in-game navigation, and multiscreen usage. And the work shown that immersive games have potential to provide higher level of enjoyment rather than normal games.

A study from (Tcha-Tokey et al., 2016) proposing a questionnaire to measure the user experience in immersive virtual environments or so called the UXIVE. The tool of the questionnaire covered all dimensions and consisted of 82 items. The questionnaire components are flow, skill, emotion, usability, technology adoption, judgement, experience consequence, and presence, engagement, immersion. The components come from the most common fields of Virtual Reality (education, entertainment, and edutainment).

A similar study from (Greenfeld et al., 2018) a comparative reality measuring component on user experience and emotion in immersive virtual environments. Through a mixed method approach by questionnaires, feedback, and interviews. It obtained new insights into participant's attitudes, interaction patterns, behavior, emotional state, and mental effort. one of the insights is higher mental effort for AR to interact than in VR. The components of the questionnaire are Engagement with VR/AR, Comfortability, Locomotion and Fluidity of Environments, Difficulty of Input Devices and UI, Scene Design Considerations, Perceived Easiness of Use, Engagement with VR and AR, and Task Difficulty.

(Jacobs et al., 2023) studied the immersive technology experience and evaluating with qualitative analysis in simulation-based education using a modified Delphi study. How Delphi study works is collecting literature review, and then panel rank most important items, and lastly started to do consensus meeting. And as a result, there were several things that should be measured on measuring user experience in immersive technology, such as what was learnt, the degree of immersion experienced, fidelity provided, debrief, psychological safety and patient safety.

Another user experience research on augmented reality run by (Davidavičienė et al., 2021) to evaluate AR mobile applications named Inkhunter and Arilyn using user experience evaluation tool. both applications have different range of installations. Inkhunter has the upper hand. The research carried out by questionnaire and expert evaluation to compare those 2 apps. The dimensions that being used on questionnaire are Attractiveness, Perspicuity, Efficiency, Dependability, Stimulation, and Novelty. The study found that for creating better augmented reality mobile apps, developers need to focus on a few key things: making sure the app's purpose is clear, keeping it easy to use and learn,

ensuring it runs smoothly, presenting information in imaginative ways, and adding interactive features.

(D. H. Shin, 2011) verified that satisfaction is influenced by users' confirmation levels with technology services. Similarly, other research consistently shows a positive connection between confirmation and satisfaction. (D. Shin, 2019). Satisfaction has been validated in technology research as a key factor of technology use and acceptance (D. H. Shin & Biocca, 2017). studies implied that continuously intention is heavily affected by user satisfaction.
From the previous research, it can be concluded that immersion is one of the factors that leads to user confirmation, user confirmation leads to satisfaction, and satisfaction leads to intention (D. Shin, 2019). And the authors will continue the research deep research about immersion, which user experience dimension have correlation with immersion. And from those flow of immersion to intention, there should be some factors of user experience that might create the immersion. And this study will declare what are those factors.

3. Research Method

3.1. Theoretical Framework

In this theoretical framework, we are figuring out the aspects of user experience that have correlations with the immersion of augmented reality games. By the previous research of (D. Shin, 2019), the result of the study says that immersion is in the user's perception, interaction with the service, and the quality of technological features that the users interact with. From immersion, it will drive users to confirmation, and from confirmation to satisfaction, and last will arrive on intention.

In this research, we are focusing on some aspects of user experience that might have correlation with the immersion feeling of the user when playing the AR game. The aspects are Brand Experience (BX), User Needs experience (NX), and Technology Experience (TX). These aspects are chosen because it's a framework to measure the user experience and it is also in line with the previous study of (D. Shin, 2019) that implied immersion comes from users' perception that could be represented by BX, interaction with the service could be represented by NX, and quality of technological features could be represented by TX. Furthermore, studies also have found that each of the aspects of the framework is related to immersion.

Where brand experiences are created, users can immerse themselves when using the product and brands through the AR brand experiences (Zeng et al., 2023). Also, technology should be developed and keep up as good as possible because immersed experience is afforded and influenced by technology(Xu et al., 2022). On top of that to achieve this immersion the user experience must meets the user requirements (D. Shin, 2019).

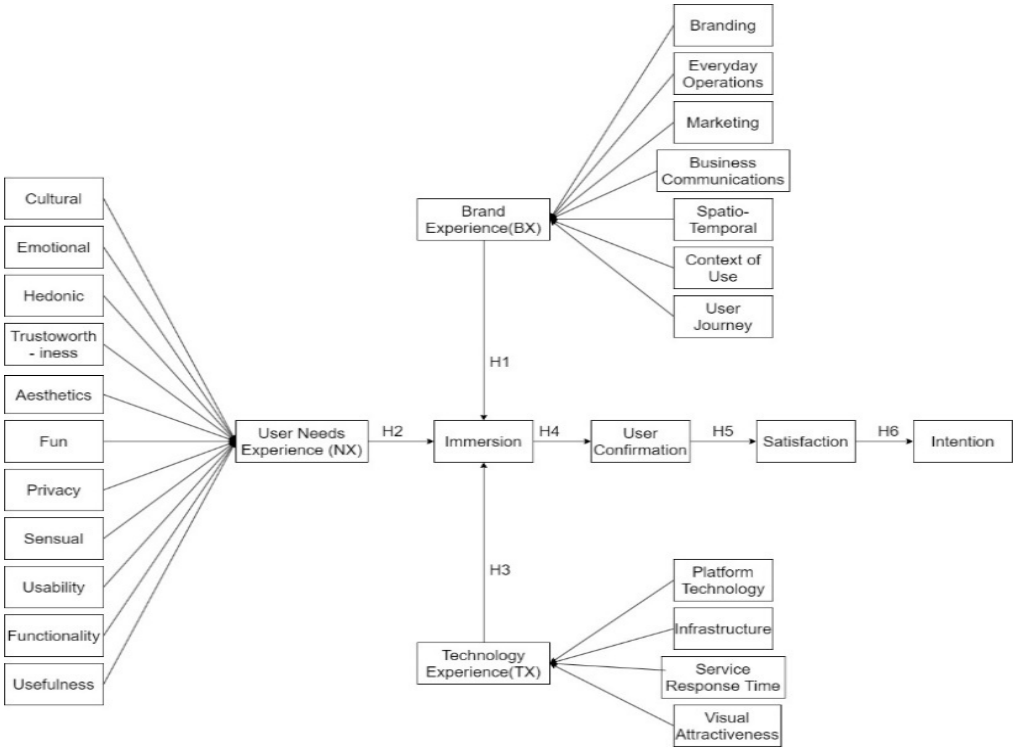

Fig.2: Modified research model

Research Approach

In this research, we are using quantitative with correlational research types. Correlational research is suit for this study because we would like to measure the relation between user experience to immersion and to find the relationship between immersion to intention. Correlational research attempts to determine the extent of a relationship between two or more variables using statistical data. Identifying strong correlations between variables can help predict outcomes or behaviors. In this type of design, relationships between Brand Experience (BX), User Needs Experience (UX), Technology Experience (TX), and Immersion are sought and interpreted.

Research Questions

In correlational research, these are the questions that will be answered in the process of quantitative research:

- Does Brand Experience, Technology Experience, and User Needs experience have correlations with immersion in augmented reality gaming?
- Does Immersion from the user experience of the AR game will make user intent play AR games?

3.2. Hypothesis

From the mentioned variables, hypotheses are developed to explore the user experience process of AR. The first, second and third hypothesis pertains to the effect of user experience dimension on immersion. As immersion is a key in the UX and its effect becoming more unique over time and players enjoy engaging experience from immersion (D. Shin, 2019). The user experience dimension that proposed by (Zarour & Alharbi, 2017) are Brand Experience, User Exprience, and Technology Exprience. Therefore there are consider as the same flow.

H1: Brand Experience has a significant effect on immersion.

H2: User Needs Experience has a significant correlation on the immersion.
H3: Technology Experience has significant effect on immersion.

Creating an immersive experience is commonly seen as a crucial objective in the development of online games (Teng, 2010). Therefore H4 will discuss about immersion on user confirmation.
H4: Immersion has a significant effect on user confirmation.

From the previous research of (D. Shin, 2019), it implied that satisfaction is influenced based on the user confirmation level on technology services.
H5: User confirmation has a significant effect on satisfaction.

Continuous intention of usage is influenced by the user satisfaction. Satisfaction has been theorized in technology acceptance research as a key factor of technology use (D. Shin, 2019).
H6: Satisfaction has a significant effect on intention.

Table 1. Operational Table

Variable	Indicator	Literature	Code
Brand Experience (BX)	Branding	(Zarour & Alharbi, 2017)	BRX01
	Everyday Operations	(Zarour & Alharbi, 2017)	BRX02
	Marketing	(Zarour & Alharbi, 2017)	BRX03
	Business Communications	(Zarour & Alharbi, 2017)	BRX04
	Context of use	(Zarour & Alharbi, 2017)	BRX05
	Spatio-Temporal	(Zarour & Alharbi, 2017)	BRX06
	User Journey	(Zarour & Alharbi, 2017)	BRX07
User Needs Experience (NX)	Cultural	(Zarour & Alharbi, 2017)	NEX01
	Emotional	(Zarour & Alharbi, 2017)	NEX02
	Hedonic	(Zarour & Alharbi, 2017)	NEX03
	Trustworthiness	(Zarour & Alharbi, 2017)	NEX04
	Aesthetics	(Zarour & Alharbi, 2017)	NEX05
	Fun	(Zarour & Alharbi, 2017)	NEX06
	Privacy	(Zarour & Alharbi, 2017)	NEX07
	Sensual	(Zarour & Alharbi, 2017)	NEX08

	Usability	(Zarour & Alharbi, 2017)	NEX09
	Functionality	(Zarour & Alharbi, 2017)	NEX10
	Usefulness	(Zarour & Alharbi, 2017)	NEX11
Technology Experience (TX)	Platform Technology	(Zarour & Alharbi, 2017)	TEX01
	Infrastructure	(Zarour & Alharbi, 2017)	TEX02
	Service response time	(Zarour & Alharbi, 2017)	TEX03
	Visual Attractiveness	(Zarour & Alharbi, 2017)	TEX04
Immersion	Lack time awareness	(Jennett et al., 2008)	IMN01
	Loss sensory awareness	(Jennett et al., 2008)	IMN02
	Involvement	(Jennett et al., 2008)	IMN03
User Confirmation	Enjoyment	(Chan et al., 2014)	USC01
	Expectation	(Chan et al., 2014)	USC02
	Experience	(Chan et al., 2014)	USC03
Satisfaction	Satisfied	(Chan et al., 2014)	STS01
	Pleased	(Chan et al., 2014)	STS02
	Delighted	(Chan et al., 2014)	STS03
Intention	Intend to play	(Chan et al., 2014)	INT01
	Continuity	(Chan et al., 2014)	INT02
	Option to use	(Chan et al., 2014)	INT03

3.3. Data and Data Collection

Data will be collected through questionnaires, and the respondents will be from all ages, men and women, but only people ever experienced playing augmented reality games. The questionnaire included items tobe answered in a five-point Likert scale. Respondents were asked to choose one answer only that according to their specific conditions. The Likert scale following ratings are: strongly disagree symbolized as 1; disagree is 2; doubtful is 3; agree is 4, and strongly agree is 5.

This research will require at least 170 responses, it could be more but could not be less. The calculation of responses is based on (Memon et al., 2020), it written that the sample-to-item ratio should not be less than 5-to-1. For example, a study with 30 questions would require 150 responses. This research has 34 questions so it would take 170 responses to make this research valid. Apparently, we could gather 214 responses and mostly is from Indonesia. Further research needs to take responses from various countries to verify other user perspectives.

The questionnaire is created using google form, so the respondent from around the country can get distributed and fill it naturally. It will be distributed through social media and gamers community of augmented reality games.

3.4. Data Analysis

To test the validity testing, reliability testing and Average Variance Extracted (AVE), will use the tools of Smart PLS. As for the hypothesis, we will carry out the testing path coefficient and t-stats. Each variable will be viewed as significant if the P -Value of the variable is smaller than 0.05 and the T-

Statistical value is greater than 1.96 (Hair et al., 2020).

Validity testing can be done by measuring the correlation between measurement items, while reliability can use the total correlation between items which is used as an indicator for measuring a variable. Indicators of each variables that value the Loading Factor below 0.7 is consider as invalid and will be removed testing in this research.

Reliability testing is a test of how consistent the measuring instrument is in measuring whatever concept is being measured. To test reliability, we will verify two things, Cronbach's alpha and composite reliability. whose value above 0.70 allows to declare them valid.

Validity testing in research involves checking to make sure that the chosen variables actually measure what they are intended to measure, which means that they are valid. If the Average Variance Extracted(AVE) value is above 0.50 then the construct in the study was declared valid. However, if the AVE value is below 0.50, then the construct in the study was not valid.

4. Result and Discussions

4.1. Respondents Profile

The data for this research has been collected through the distribution of various social media, such as Instagram, WhatsApp, line, and LinkedIn. The data is collected in the form of google form and we have successfully collected 229 number of respondents. The data that has been collected is valid because we have separated respondents who have played and have not played the augmented reality. There are 15 respondents who do not play the augmented reality. So, we only calculate the data analysis for 214 data.

Table 2. Respondents profile

Category	Description	Frequency	(%)
Gender	Male	155	62%
	Female	59	28%
Age	< 19 years	4	2%
	20-25 years	184	86%
	26-30 years	19	9%
	> 30 years	7	3%
Domicile	Jabodetabek	154	72%
	Outside Jabodetabek	56	26%
	Outside Indonesia	4	2%
Job	Working	119	56%
	Student	81	38%
	Entrepreneur	14	6%
Platform on playing AR Games	Android	139	65%
	iOS	75	35%
AR games	Pokémon GO	95	44%
	Ingres Prime	41	19%
	Angry Birds AR	57	27%
	Knightfall AR	17	8%
	Other	4	2%

Duration of playing the game	Below 1 week	66	30%
	Over 1 week	67	31%
	Over 1 month	81	38%

4.2. Validity and Reliability Test

To check the validity and reliability of indicators for all the variables, we have used Smart PLS to verify these. Indicators that have below 0.7 of loading factor will be removed. Currently there are 4 indicators from BX and 5 indicators from NX that have been removed.

Table 3. Validity test and loading factor result

Variable	Code	LF	AVE
Brand Experience (BX)	BRX03	0.769	0.626
	BRX06	0.757	
	BRX07	0.845	
User Needs Experience (NX)	NEX01	0.776	0.687
	NEX03	0.706	
	NEX04	0.738	
	NEX05	0.767	
	NEX07	0.744	
	NEX08	0.712	
Technology Experience (TX)	TEX01	0.812	0.591
	TEX02	0.735	
	TEX03	0.789	
	TEX04	0.735	
Immersion	IMN01	0.853	0.687
	IMN02	0.864	
	IMN03	0.766	
User Confirmation	USC01	0.850	0.685
	USC02	0.826	
	USC03	0.807	
Satisfaction	STS01	0.867	0.718
	STS02	0.843	
	STS03	0.833	
Intention	INT01	0.858	0.697
	INT02	0.833	
	INT03	0.814	

Reliability test on this research is by looking unto the Cronbach alpha and composite reliability. Both should be above 0.7. and as a result, all the variables are above 0.7 means that they are accepted.

Table 4. Reliability test result

Variable	Cronbach Alpha	Composite Reliability
Brand Experience (BX)	0.702	0.834
User Needs Experience (NX)	0.837	0.848
Technology Experience (TX)	0.770	0.852
Immersion	0.771	0.868
User Confirmation	0.770	0.867
Satisfaction	0.804	0.884
Intention	0.784	0.874

4.3. Hypothesis Result

Table 5. Path coefficient table

Hypothesis	Original Sammple(O)	Sample mean(M)	Standard Deviation (STDV)	T-Stat	P Values	Results
Brand Experience → Immersion	0.658	0.658	0.045	14.673	0.000	Accepted
User Need Experience → Immersion	0.199	0.202	0.076	9.726	0.000	Accepted
Technology Experience → Immersion	-0.107	-0.102	0.062	1.729	0.084	Rejected
Immersion → User Confirmation	0.661	0.663	0.057	11.511	0.000	Accepted
User Confirmation → Satisfaction	0.633	0.634	0.065	9.726	0.000	Accepted
Satisfaction → Intention	0.587	0.589	0.076	7.740	0.000	Accepted

H1: Brand Experience has a significant effect on immersion.

Based on the findings from the questionnaire, it shows that brand experience does have a significant effect on immersion with T-stat value 14.673 and p values 0.000. As previous study of (Zeng et al., 2023) studied that brand experience has a relationship with immersion. And (Shen et al., 2020; Zarour & Alharbi, 2017) has mentioned in the user experience framework that Brand Experience could be measured, this result has the according to this study. Therefore, H1 is accepted.

H2: User Needs Experience has a significant correlation on the immersion.

Based on the findings from the questionnaire, it shows that user needs experience does have a significant effect on immersion with T stat value is 9.726 and p values with 0.000. As previous study of (Kallioniemi et al., 2017; Lugrin et al., 2013; D. Shin, 2019) studied that user experience has a relationship with immersion in terms of AR and games. And (Zarour & Alharbi, 2017) has mentioned in the user experience framework that User Need Experience could be measured, this result has the according to this study. Therefore, H2 is accepted.

H3: Technology Experience has significant effect on immersion.

Based on the findings from the questionnaire, it shows that Technology Experience does not have a significant effect on immersion because the T stat value is 1.729 and p values 0.084. According to (Zarour & Alharbi, 2017) framework that Technology Experience could not be measured by questionnaire. So, the result is according to this study. Therefore, H3 is not accepted.

H4: Immersion has a significant effect on user confirmation.

Based on findings from the questionnaire, it shows that Immersion has a significant effect on user confirmation with T stat value 11.151 and p values 0.000. This result has the same result of (D. Shin, 2019) study. Therefore, H4 is accepted.

H5: User confirmation has a significant effect on satisfaction.

Based on findings from the questionnaire, it shows that user confirmation has a significant effect on satisfaction with T stat value 9.726 and p values 0.000. This result has the same result of (D. Shin, 2019) study. Therefore, H5 is accepted.

H6: Satisfaction has a significant effect on intention.

Based on findings from the questionnaire, it shows that satisfaction has a significant effect on intention with T stat value 7.740 and p values 0.000. This result has the same result of (D. Shin, 2019) study. Therefore, H6 is accepted.

5. Conclusions and Future Work

Researchers and business experts think that the augmented reality market will grow, more people will use it, and there will be more scientific research interest in the coming years. Although augmented reality games are becoming more popular worldwide, there hasn't been enough research to fully understand the user experience behind it. Developers of AR games need to be ready to serve and follow up the user experience that will be needed.

In summary, these three experiences are interconnected and contribute to the overall success of a product or service. A well-thought-out brand experience, combined with a user-friendly and technologically sound product, can create a holistic and positive experience for the end-user, fostering brand loyalty and success in the market.

The result of this study ensure that Brand Experience (BX) and User Need Experience (NX) does have a correlation on Immersion. It is also supported by previous works of other researchers. But at this study, we find out that there are only some of indicators from BX and NX that really matters to Immersion. All the user experience that needs to be focused is Brand Experience which are Marketing, Spatio-Temporal, and User Journey. And as for the User Need Experience are Cultural, Hedonic, Trustworthiness, Aesthetic, Sensual, and Privacy. After that, the user will intentionally play the game furthermore.

By this study, it discovered clearer effect of user experience dimension on AR gaming. These data could be used for engaging the user with the right strategy of immersion based on user experience immersion. And to overcome the challenges that are exist in user experience on the technology of AR.

Based on the result that shows Technology Experience does not show a significant effect on immersion. Because it could not be measured by a questionnaire, and it should be measured by prototype and expert reviews (Zarour & Alharbi, 2017). The insights that could be given to future developers of augmented reality to measure the Technology Experience by prototype and expert reviews. Technology should be maintained as normal as possible. There is a standard for the software, hardware, and a few things that should be served to the user.

This study has dig correlational relationship from user experience to intent to play and appears that immersion could lead user to intent to play AR games. As the user feels the immersive experience, they will move to user confirmation, and from user confirmation they will move to satisfaction, and lastly after they felt satisfaction, they will arrive at intention to play the AR games. The entry point of user to stay or to intent to play the AR game is starting from the user experience of the AR game.

As of right now, not many games of AR that still survive in the market of AR games. Yet maybe they survive but not with a dozen users playing. And Pokémon Go is still the number one AR game that is favorite by worldwide users. Based on the results from this research, the entry point for user to intent to play is from the user experience, then to immersion, it will flow until intention feelings to play. So, it's important for developers to develop a good user experience on the right point. Users will naturally have the intention to play the AR games again.

The limitation of this study is that most of the respondents are coming from Indonesia only, meaning that augmented reality game user from around the world could have different opinion and point of view about the questions of google forms. Future research could gather much more quantity of respondents from several countries to see other user perspectives and experiences.

References

Arth, C., Grasset, R., Gruber, L., Langlotz, T., Mulloni, A., & Wagner, D. (2015). *The History of Mobile Augmented Reality*. http://arxiv.org/abs/1505.01319

Azuma, R. T. (1997). A Survey of Augmented Reality. In *Presence: Teleoperators and Virtual Environments* (Vol. 6). http://www.cs.unc.edu/~azumaW:

Chan, T. K. H., Cheung, C. M. K., & Lee, Z. W. Y. (2014). Investigating the continuance intention to play massively multi-player online games. *International Journal of Business and Information*, *9*(2), 160–186. https://doi.org/10.6702/ijbi.2014.9.2.2

Cheok, A. D., Fong, S. W., Goh, K. H., Yang, X., Liu, W., & Farzbiz, F. (2003). Human Pacman: A sensing-based mobile entertainment system with ubiquitous computing and tangible interaction. *Proceedings of the 2nd Workshop on Network and System Support for Games, NetGames 2003*, 106–117. https://doi.org/10.1145/963900.963911

Christou, G. (2014). The interplay between immersion and appeal in video games. *Computers in Human Behavior*, *32*, 92–100. https://doi.org/10.1016/j.chb.2013.11.018

Davidavičienė, V., Raudeliūnienė, J., & Viršilaitė, R. (2021). Evaluation of user experience in augmented reality mobile applications. *Journal of Business Economics and Management*, *22*(2), 467–481. https://doi.org/10.3846/jbem.2020.13999

Faqih, K. M. S. (2022). Factors influencing the behavioral intention to adopt a technological innovation from a developing country context: The case of mobile augmented reality games. *Technology in Society*, *69*. https://doi.org/10.1016/j.techsoc.2022.101958

Ghazwani, Y., & Smith, S. (2020). Interaction in Augmented Reality: Challenges to Enhance User Experience. *ACM International Conference Proceeding Series*, 39–44. https://doi.org/10.1145/3385378.3385384

Greenfeld, A., Lugmayr, A., & Lamont, W. (2018). Comparative reality: Measuring user experience and emotion in immersive virtual environments. *Proceedings - 2018 IEEE International Conference on Artificial Intelligence and Virtual Reality, AIVR 2018*, 204–209. https://doi.org/10.1109/AIVR.2018.00048

Hair, J. F., Howard, M. C., & Nitzl, C. (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. *Journal of Business Research*, *109*, 101–110. https://doi.org/10.1016/j.jbusres.2019.11.069

Irshad, S., & Rambli, D. R. B. A. (2015). User experience of mobile augmented reality: A review of studies. *Proceedings - 2014 3rd International Conference on User Science and Engineering: Experience. Engineer. Engage, i-USEr 2014*, 125–130. https://doi.org/10.1109/IUSER.2014.7002689

Jacobs, C., Foote, G., & Williams, M. (2023). Evaluating user experience with immersive technology in simulation-based education: A modified Delphi study with qualitative analysis. *PLoS ONE*, *18*(8 August). https://doi.org/10.1371/journal.pone.0275766

Jennett, C., Cox, A. L., Cairns, P., Dhoparee, S., Epps, A., Tijs, T., & Walton, A. (2008). Measuring and defining the experience of immersion in games. *International Journal of Human Computer Studies*, *66*(9), 641–661. https://doi.org/10.1016/j.ijhcs.2008.04.004

Kallioniemi, P., Mäkelä, V., Saarinen, S., Turunen, M., Winter, Y., & Istudor, A. (2017). *User Experience and Immersion of Interactive Omnidirectional Videos in CAVE Systems and Head-Mounted Displays*. 299–318. https://doi.org/10.1007/978-3-319-68059-0_20ï

Lugrin, J. L., Cavazza, M., Charles, F., Le Renard, M., Freeman, J., & Lessiter, J. (2013). Immersive FPS games: User experience and performance. *ImmersiveMe 2013 - Proceedings of the 2nd International Workshop on Immersive Media Experiences, Co-Located with ACM Multimedia 2013*, 7–12. https://doi.org/10.1145/2512142.2512146

Memon, M. A., Ting, H., Cheah, J.-H., Thurasamy, R., Chuah, F., & Cham, T. H. (2020). Sample Size for Survey Research: Review and Recommendations. *Journal of Applied Structural Equation Modeling*, *4*(2), i–xx. https://doi.org/10.47263/jasem.4(2)01

Milgram, P., & Kishino, F. (1994). A Taxonomy of Mixed Reality Visual Displays ActiveCube View project Using Stereoscopic Video for Defence Teleoperation View project A TAXONOMY OF MIXED REALITY VISUAL DISPLAYS. In *IEICE Transactions on Information Systems* (Issue 12). http://vered.rose.utoronto.ca/people/paul_dir/IEICE94/ieice.html

Minge, M., & Thüring, M. (2018). Hedonic and pragmatic halo effects at early stages of User Experience. *International Journal of Human Computer Studies*, *109*, 13–25. https://doi.org/10.1016/j.ijhcs.2017.07.007

Nilsen, T. T., Nilsen, T., Linton, S., & Looser, J. (2014). *Motivations for ar gaming Motivations for Augmented Reality Gaming*. https://www.researchgate.net/publication/246873651

Olsson, T., Lagerstam, E., Kärkkäinen, T., & Väänänen-Vainio-Mattila, K. (2013). Expected user experience of mobile augmented reality services: A user study in the context of shopping centres. *Personal and Ubiquitous Computing*, *17*(2), 287–304. https://doi.org/10.1007/s00779-011-0494-x

Ozdemir, M., Sahin, C., Arcagok, S., & Demir, M. K. (2018). Öğrenme sürecinde artırılmış gerçeklik uygulamalarının etkililiği: Bir meta-analiz çalısması. *Egitim Arastirmalari - Eurasian Journal of Educational Research*, *2018*(74), 165–186. https://doi.org/10.14689/ejer.2018.74.9

Shen, J., Wang, Y., Chen, C., Nelson, M. R., & Yao, M. Z. (2020). Using virtual reality to promote the university brand: When do telepresence and system immersion matter? *Journal of Marketing Communications*, *26*(4), 362–393. https://doi.org/10.1080/13527266.2019.1671480

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. https://doi.org/10.1080/1369118X.2017.1411519

Shin, D. H. (2011). Understanding e-book users: Uses and gratification expectancy model. *New Media and Society*, *13*(2), 260–278. https://doi.org/10.1177/1461444810372163

Shin, D. H., & Biocca, F. (2017). Explicating user behavior toward multi-screen adoption and diffusion: User experience in the multi-screen media ecology. *Internet Research*, *27*(2), 338–361. https://doi.org/10.1108/IntR-12-2015-0334

Souza, K. E. S. de, Aviz, I. L. de, Mello, H. D. de, Figueiredo, K., Vellasco, M. M. B. R., Costa, F. A. R., & Seruffo, M. C. da R. (2022). An Evaluation Framework for User Experience Using Eye Tracking, Mouse Tracking, Keyboard Input, and Artificial Intelligence: A Case Study. *International Journal of Human-Computer Interaction*, *38*(7), 646–660. https://doi.org/10.1080/10447318.2021.1960092

Stenros, J. (2017). The Game Definition Game: A Review. *Games and Culture*, *12*(6), 499–520. https://doi.org/10.1177/1555412016655679

Tcha-Tokey, K., Loup-Escande, E., Christmann, O., & Richir, S. (2016, March 23). A questionnaire to measure the user eXperience in immersive virtual environments. *ACM International Conference Proceeding Series*. https://doi.org/10.1145/2927929.2927955

Teng, C. I. (2010). Customization, immersion satisfaction, and online gamer loyalty. *Computers in Human Behavior*, *26*(6), 1547–1554. https://doi.org/10.1016/j.chb.2010.05.029

Thomas, B., Close, B., Donoghue, J., Squires, J., De Bondi, P., Morris, M., Piekarski, W., & Au, U. (2000). *ARQuake: An Outdoor/Indoor Augmented Reality First Person Application*.

Wu, H. K., Lee, S. W. Y., Chang, H. Y., & Liang, J. C. (2013). Current status, opportunities and challenges of augmented reality in education. *Computers and Education*, *62*, 41–49. https://doi.org/10.1016/j.compedu.2012.10.024

Xu, X., Kang, J., & Yan, L. (2022). Understanding embodied immersion in technology-enabled embodied learning environments. In *Journal of Computer Assisted Learning* (Vol. 38, Issue 1, pp. 103–119). John Wiley and Sons Inc. https://doi.org/10.1111/jcal.12594

Yuen, S. C.-Y., Yaoyuneyong, G., & Johnson, E. (2011). Augmented Reality: An Overview and Five Directions for AR in Education. *Journal of Educational Technology Development and Exchange*, *4*(1). https://doi.org/10.18785/jetde.0401.10

Zarour, M., & Alharbi, M. (2017). User experience framework that combines aspects, dimensions, and measurement methods. *Cogent Engineering*, *4*(1). https://doi.org/10.1080/23311916.2017.1421006

Zeng, J. Y., Xing, Y., & Jin, C. H. (2023). The Impact of VR/AR-Based Consumers' Brand Experience on Consumer–Brand Relationships. *Sustainability (Switzerland)*, *15*(9). https://doi.org/10.3390/su15097278