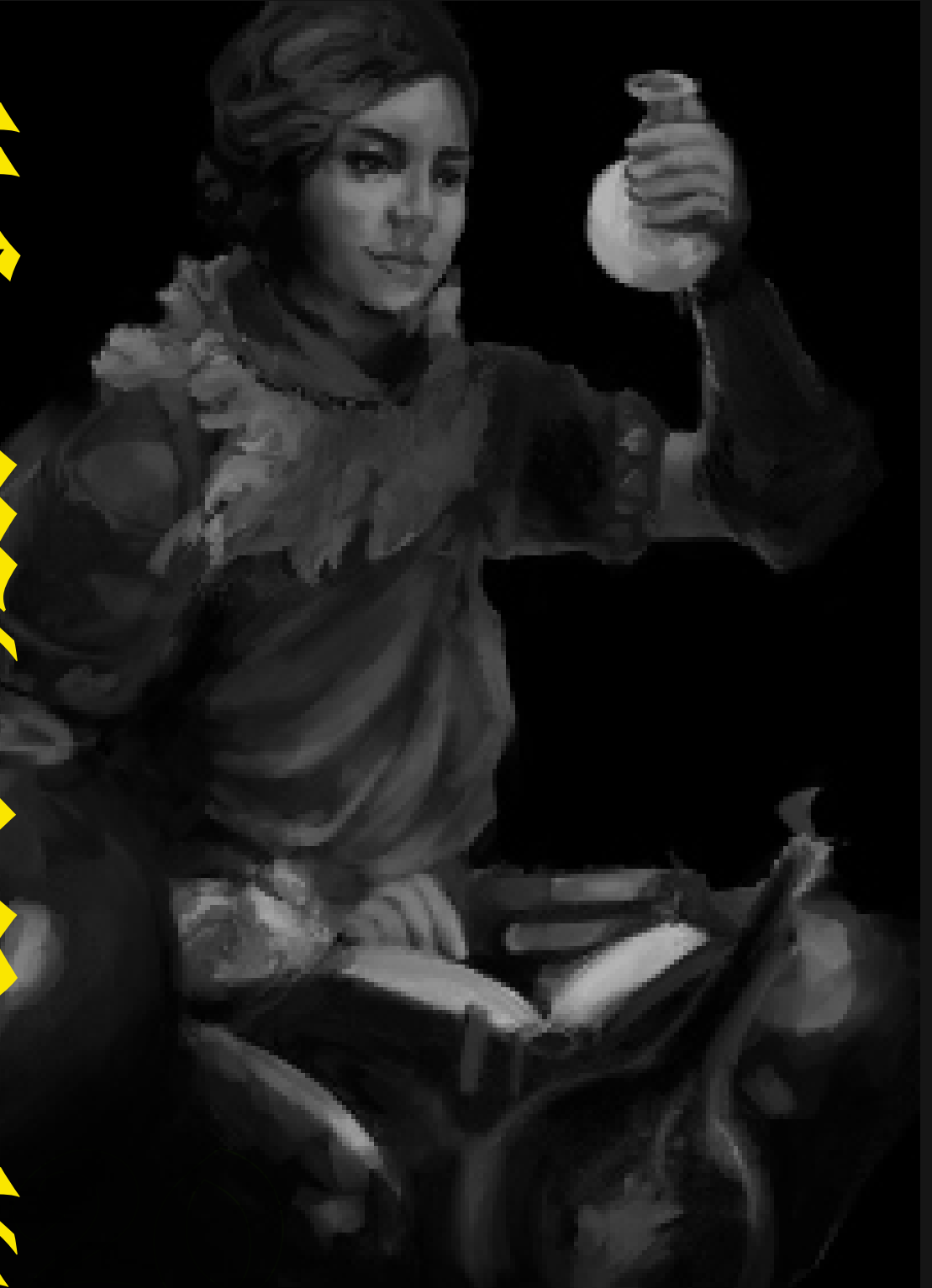


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TE HERENGA WAKA, VICTORIA UNIVERSITY OF WELLINGTON

# Roll for Mixed Reality



BY  
THOMAS TRENGROVE

HOW CAN MIXED REALITY BE USED TO ENHANCE IMMERSION AND GAMEPLAY EXPERIENCE IN TABLETOP ROLEPLAYING GAMES THAT ARE PLAYED USING MINIATURES?

# Roll For Mixed Reality

A Mixed Reality Toolbox for Tabletop Roleplaying Games

by

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A Masters Thesis  
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# Abstract

How can Mixed Reality be used to enhance immersion and gameplay experience in tabletop roleplaying games that are played using miniatures?

Mixed Reality (MR) is a growing area of interest in the tabletop board game market as a way of heightening the ways gamers can interact with physical games. Traditional tabletop roleplaying games (TTRPG) such as *Dungeons & Dragons* (D&D) and *Warhammer* are well known for their immersive phenomenological narrative experiences (White, 2014) and engaging analogue interaction with tangible game pieces (Liu et al, 2021). MR offers new ways of building on these elements to enhance the immersive and haptic interactive gameplay experience while retaining the popular elements of TTRPGs. This research explores the technical possibilities and limitations of holographic headsets such as the Microsoft HoloLens with the purpose of enhancing the TTRPG experience. By Exploring the potential of enhanced visuals and streamlined interaction, while mitigating the loss of tactility that other digital TTRPG formats often cause, this project also seeks to quantify the immersive engagement that these changes may provide.

# Acknowledgements

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All my playtesters and my friends who helped this process: Ben, Sian, Matt & Jarred. Thank you.

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# Chapter 01

Mixed Reality (MR) is a growing area of interest in the tabletop board game market due to its potential for providing a way of enhancing the ways gamers can interact with their physical games. Traditional table-top roleplaying games (TTRPG) such as *Dungeons & Dragons* (D&D) are well known for their immersive phenomenological narrative experiences (White, 2014) and engaging analogue interaction with tangible game pieces (Liu et al, 2021). MR offers new ways of building on these elements to enhance the immersive and haptic interactive gameplay experience, while retaining the popular elements of TTRPGs that are played with miniatures.

### Motivation:

I love Dungeons & Dragons and all the love for the craft that goes into the process. I also love interactive technologies such as Virtual Reality and Mixed Reality. So why not put the two together?

# Research Overview

## 1. Introduction

The introduction presents a rationale for the project.

## 2. Literature & Precedent Review

This chapter seeks to define immersion within the context of tabletop role-playing games such as *Dungeons & Dragons*. It also seeks to define Mixed Reality and its application to TTRPGs. It also shows MR capabilities in a commercial context.

## 3. Methodology

This chapter provides an overview of each methodology used for the research process.

## 4. Survey Results

This chapter describes the survey process and illustrates the results found of the qualitative and quantitative survey data found.

## 5. Prototyping & Playtesting

This chapter seeks to realise key themes of the survey into the form of MR prototypes. It shows the problems overcome and current issues with MR technology. This is then followed by the playtesting process used to iterate the prototypes.

## 6. Discussion & Conclusion

This chapter gives a summary of each chapter. It then provides a interpretation of outcomes, strengths, implications, lessons learnt from this space, and what's next.

## Aims & Objectives

1. Define and investigate the key elements of immersion in TTRPGs, what elements players find enjoyable, and what existing digital aids exist for TTRPGs. Investigate immersive applications in MR and current MR Design precedents, and establish which features TTRPG players would like to see incorporated within a MR TTRPG experience and which feature they would prefer to remain analogue.

- 1a. Analyse existing research within the field of immersion in TTRPGs and MR.
- 1b. Investigate player enjoyability, engagement and immersive experience with TTRPGs, Digital aids and MR Devices through an online survey. Explore which features they prefer to be presented in analogue format and which digitally.
- 1c. Create a visual map of key elements of players' overall enjoyment and immersive experience with TTRPG, Digital aids and MR Devices.

2. Investigate how players interact with a variety of gameplay elements from various tabletop and mixed reality games.

- 2a. Design a series of Mixed-Reality prototypes that assist with playing TTRPGs.
- 2c. Evaluate the results to create the desired package of enjoyable MR elements for the TTRPG.

# Chapter

# 02

## 02

The purpose of this literature review is to define the phenomenon of immersion as it applies to traditional table-top roleplaying games. It then seeks to define what Mixed Reality is for the purposes of gaming within TTRPGs. It also examines MR design precedents that utilise immersion as a gameplay mechanism, for the goal of enhancing the immersive experience within TTRPGs. The review then shows successful uses of MR in a commercial space contextualise it as viable consumer technology .

This chapter is organised into five sections. The first section defines key terms and indicates how these key ideas are understood in the thesis. The second section explores the relationship between Dungeons & Dragons and digital technologies in the context of enhancing the immersive experience beyond the phenomenological experience. The third section defines Mixed Reality to put it in the context of gaming and tabletop roleplaying games. The fourth section explores current commercial uses of MR in order to demonstrate their relevance to consumers. The final section of this chapter indicates how the ideas discussed in the chapter will be explored in the subsequent chapters.

# Definitions

## Oxford Dictionary (2020) Definitions:

**Immersion:** the state of being completely involved in something.

**Role-Playing Game (RPG):** a game, often an online or computer game, in which players pretend to be imaginary characters who take part in adventures, especially in situations from fantasy literature.

**Virtual Reality (VR):** images and sounds created by a computer that seem almost real to the user, who can interact with them by using sensors.

**Augmented Reality (AR):** a technology that combines computer-generated images on a screen with the real object or scene that you are looking at.

**Phenomenology:** the purpose of phenomenology is to describe what it is like to be conscious or to have a given experience.



# Defining key terms

## What are ttrpgs?

Although the first published TTRPG *Dungeons & Dragons* (Gygax & Arneson, 1974), appeared in 1974, there is still considerable controversy surrounding the way in which TTRPGs are defined. The phrase “role-playing games” refers to a plurality of forms across media – including TTRPGs, computer RPGs (CRPGs), (massively) multiplayer online RPGs (MORPGs), live-action RPGs (larps), and more (Zagal & Deterding, 2018). In tabletop role-playing, Zagal and Deterding (2018) argue that the game world is defined predominantly through verbal communication. One early attempt to define TTRPGs, quoted in Gary Alan Fine’s seminal (1983) ethnography of TRPG players, is Stephen Lortz’s “any game which allows a number of players to assume imaginary characters and operate with some degree of freedom in an imaginary environment” (Lortz, 1979, as cited in Fine, 1983, p. 6). Schick expanded on this definition by identifying some of the characteristics associated with RPGs, arguing that a role-playing game must consist of quantified interactive storytelling”, that its “character abilities and action resolution must be defined by numbers or quantities that can be manipulated following certain rules”, that action is driven forward by “player decision-making” and that the story itself has the following characteristics – it has “a group for an author, a story that grows organically and is acted out, is experienced by its creators” (Schick 1991, 10–11).

## Immersion

The Oxford Dictionary defines immersion as “the state of being completely involved in something.” Despite this common-sense meaning, this definition provides no clear idea of what immersion means within gaming. Jennett et al. (2008) investigated and attempted to measure and define the experience of immersion within games by running a series of experiments. The first experiment investigated participants’ abilities to switch from an immersive to a non-immersive task. The second experiment investigated whether there were changes in participants’ eye movements during an immersive task. The third experiment investigated the effect of an externally imposed pace of interaction on immersion and affective measures (state anxiety, positive affect, negative affect). Overall, the findings suggest that immersion can be measured subjectively (Jennett et al. 2008).

Cairns et al (2004, p. 1298) conducted a videogame study in an attempt to define immersion based on the experiences of seven gamers (the participants were all English speakers, aged 18 and above, who regularly played computer games.) and concluded that:

As intuitive as the word suggests, the resulting grounded theory found that

immersion is indeed used to describe the degree of involvement with a computer game. The theory also identified a number of barriers that could limit the degree of involvement. These barriers arose from a combination of human, computer and contextual factors (e.g., gamer preference, game construction, environmental distractors), and the type of barrier suggested different levels of immersion.

These researchers identified three distinct levels of immersion in their study, the first of which was engagement. They argue that engagement is necessary if the gamer is to overcome the barrier of preference, given that gamers need to invest time, effort, and attention in the game. Cairns et al (2004) refer to the second level of immersion as engrossment, which, they argue, involves overcoming the barrier of game construction. The game needs to come together in such a way that player's emotions are directly affected by the game, and the controls become invisible. From then on, they claim the player can become totally immersed, overcoming the barriers of empathy and atmosphere, and entering the final level of total immersion, where the player is cut off from reality.

While Brown and Cairns' (2004) study is compelling in its description of the key attributes of immersion within games, it is nevertheless flawed. First, the existence of three distinct levels

of immersion is debatable, which raises some important questions when this view of a true immersive experience is applied to a traditional TTRPG experience. Can a person be truly immersed despite the barrier represented by the screen and in the absence of a grounding in reality? What are the moral implications of providing the tools which enable the player to become totally engrossed in a game? Furthermore, the outcomes of Cairns et al.'s (2004) study cannot be applied with modern accuracy to the more complex VR/AR technology in existence today. However, the core idea of players becoming engrossed in the play of the game remains strong.

# Dungeons & Dragons and Digital technologies

## Immersion in Dungeons & Dragons

White's (2014) exploration of the phenomenology of immersion as it relates to the tabletop game Dungeons and Dragons yields great insight through the presentation of arguments made between game designers and social scientists on the varying and incompatible definitions of immersion. White (2014) tells us:

Immersion is a sprawling concept, understood as having to do with being engrossed in the play of a game, or identifying strongly with a character in a story, or feeling as if one were in some sense present in an imaginary setting, for example. It is sometimes associated with psychologist Michael Csikszentmihalyi's concept of "flow," in which "optimal experience" is achieved when an undertaking challenges but doesn't overwhelm us (Csikszentmihalyi, 1990). Discussions of immersion among gamers can at times be heated, because of the varying and incompatible definitions held by different people (White et al, 2012).

Such varying definitions are made by game design gurus Eric Zimmerman and Katie Salen and (2003) who argue that the increasingly realistic depiction of an imaginary environment created by technical means is not responsible for immersion. They argue this is known as the "immersive fallacy," and immersion is found in the minds of the players, in their play

experience, rather than the medium's technical maturity, verisimilitude, or "realism." White (2014) sides with Zimmerman and Salen stating that "once we begin to see immersion as a function of the game-player's subjective experience, rather than of the technical means used to create that experience, the door is opened to a phenomenological approach to immersion."

There are a few ideas present that I agree strongly within their application in TTRPGs. The idea that immersion functions as a mechanism of the mind and creates a phenomenological experience in TTRPGs appeals in that all you need to play D&D is a good narrative and people to experience and interact with that narrative. However, in referring to the immersive fallacy and white's (2014, p. 84) statement "Once we begin to see immersion as a function of the game-player's subjective experience, rather than of the technical means used to create that experience", both claim that the technological means used to construct the experience play no part in immersion. I would argue that the phenomenological experience is traditionally facilitated by a range of technologies particularly in D&D. For example, in the Dungeons & Dragons Dungeon Master's Guide, Mearls, Crawford et. Al (2014), describes throughout the flow of play the ideas associated with this are basic technologies such as verbal (a vivid

description by the GM), narrative (a compelling plot) and role play (deep engagement with our character), and by using these traditional tools they facilitate and deliver the phenomenological experience of D&D.

Mearls & Crawford et al (2014) also illustrate that players of TTRPGs also use a range of analogue technologies to support their Dungeons & Dragons experience, for instance by using paper character sheets, paper rule books, dice, miniatures sometimes including terrain/landscape props), maps/ grids and visual aids (illustrations and props such as in-game documents). These analogue technologies also appear in digital form as a means to streamline the experience such as in D&D Beyond – which uses character sheets and rules information for playing the game on laptops, tablets, or phones (D&D Beyond, n.d.) and in virtual tabletops (VTTs) such as Roll20 which uses digital maps/ grids, dice-rolling, character sheets (sometimes with number-crunching) and tokens, resulting in “digital theatre” which incorporates sound & imagery (Roll20 n.d.).

# Mixed Reality in the Context of tfrpgs

## Defining Mixed Reality

A number of issues have been identified in attempts to define Mixed Reality (Speicher et al, 2019). In an effort to come up with a definition Speicher and his colleagues reviewed 68 published academic papers and interviewed 5 and 5 from the gaming industry whom they identified based on their experience and leadership in the AR/VR field. All ten interviewees (referred to as J1 – J10 in the paper) had at least two years of experience; however, eight of them had more than eight years of experience working with AR, MR, and/or VR technologies.

When asked to define MR the group of experts came up with several contradictory definitions. Two experts each defined MR by referring to AR as well as full immersion, suggesting the possibility of including both AR and VR in the same app or on the same device. Other participants argued that “MR is the combination of real and virtual (J6), [and] that MR is bound to specific hardware (e.g., HoloLens; J6)”. The outcome of Speicher et al’s (2019) study indicates that they struggled to define MR, while the distinction between MR and VR is clearer, with a tendency to be based mainly on visual and hardware aspects. Speicher et al (2019) suggested that spatial registration and the possibility of the game-player seeing at least some part of the physical environment constituted defining features of MR. However, they also concluded that it is unlikely that

a single definition of MR exists.

In their (2009) chapter, Costanza et al., refer to MR in the context of hardware in MR systems, where “users perceive both the physical environment around them and digital elements presented through, for example, the use of semitransparent displays” (2009, p. 48). Costanza also draws on a definition of MR included in a paper by Milgram et al. (1997, p. 2) which describes MR as a “subclass of VR-related technologies that involve merging of real and virtual worlds”. AR is therefore often considered to be a branch of MR. So, Costanza et al, (2009, p. 48) distinguish between MR and AR by arguing that “MR includes systems in which the virtual aspects are dominant as well as those in which the physical reality is dominant. Within this range, augmented reality has more physical elements than virtual elements.”

Speicher et al’s (2019) attempt at distinctions show that it is difficult to come up with a general definition of MR. However, once the focus is narrowed down to the context of MR systems as opposed to MR as general concept, Costanza et al (2009) & Milgram et al (1997) demonstrated that distinctions can be made in relation to VR, MR & AR. MR devices generally use VR-Related technologies that involve the merging of real and

virtual worlds and involve a combination of virtual and physical elements that are both dominant (whereas physical elements are more dominant than virtual elements in AR, according to Costanza et al (2009, p. 48) For the purposes of this thesis, I will discuss MR in a way that reflects the definitions provided by Costanza et. Al. (2009) and Milgram et al. (1997).

## Linking Immersive Gameplay Within Mixed Reality Games.

In Hu et al's. (2016) study of the impact of physical and cognitive on reported immersion for an MR game called 'Beach Pong'. 68 players engaged with 34 games (24 physical challenges and 10 cognitive challenges). The game is a

mashup of beach volleyball and the classic video game Pong. It takes place on a real beach volleyball court. Players hold large foam paddles resembling the classic Pong paddle, and shimmy side to side on either end of the sand court in order to hit a virtual ball. "Holes" (depressions) are detected in the sand and when they are beyond a certain depth threshold, animated virtual lava is projected in and around the hole. A player will lose the round if they step on the lava. The virtual ball is visible to players on a 3D viewfinder embedded in the paddle. A grid of LED lights placed on the sand between the players also shows the position and heading of the virtual ball. Players score if their opponent misses the virtual ball (Hu et al, 2016, p. 947).

From this experiment Hu et al. (2016, p. 947) found that "Contrary to prior findings for desktop games, we find significantly higher reported immersion among players who engage physically, regardless of their actual game performance." The participants

in this mixed reality study who actively attended to both physical and virtual game elements reported higher immersion levels than those who exclusively or, mainly, remained using virtual elements.

Hu et al's findings achieve a grounded and immersive mixed reality experiment. Their results illustrate that when players are both physically and cognitively engaged in mixed reality games, this leads to immersion players are doing while thinking. This finding contrasts with Zimmerman & Salen's (2003) immersive fallacy which viewed immersion as located in the mind. Hu et al (2016, p. 955) conclude that a mixed reality immersion (fig 1) model represents the relationship between multiple spaces, physical and cognitive challenges, and immersion.

I agree with Hu et al's findings. In my opinion Mixed Reality precedents such as this create an immersion of the senses. Interacting with a tactical environment and using the senses in collaboration with digital engagement led me to believe these are key experiences of successful gameplay immersion in MR.

Link et al (2016) applies similar sensory engagement within a Mixed Reality table-top design precedent titled "An intelligent multimodal mixed reality real-time strategy game". This precedent utilises a Mixed Reality tabletop role-playing to combine digital interactive surfaces that augment traditional physical setups (such as pen & paper) with virtual elements and touch-based interactions to create a Mixed Reality. "These environments overcome the static nature of traditional tabletop games. However, they preserve the three fundamental characteristics of these types of games, notably haptic interaction using physical game elements (cards and playing pieces), a co-located space that maintains mutually accessible frames of reference, and the rich variety and subtleties of interpersonal communication signals for social interactions" (Link et al., 2016 p.223). The mixed reality table-top design works well in demonstrating which aspects of 'Beach Pong' succeeded where they incorporate virtual gameplay elements into the real world. This seems to work well because it encourages players to engage cognitively with the board, provides haptic feedback, and generates social interaction. Cognitive immersion, spatial immersion and social immersion are all consistent elements of MR Gameplay.

## Commercial Mixed Reality Devices

Within the commercial market several well-known devices have emerged that build upon applying mixed reality within the interactive experience. The Microsoft HoloLens 2 is a Mixed-Reality headset marketed for hands-free holographic interaction and collaboration within the manufacturing, healthcare, and educational industries (Microsoft, 2022). The headset utilises depth and head-tracking sensors to position the holograms in the user's physical space. To interact with the digital environment, the headset uses fully articulated hand tracking, touch, grasp and move holograms. Furthermore, the device adapts to the user's hands, so that the holograms respond like real objects (Microsoft 2022).

Within the domain of TTRPGs, the Tilt Five headset, one of the first consumer-focused AR systems, came to prominence as example of AR technology specifically designed for the purpose of playing TTRPGs (Tilt Five 2022). The system expands on/develops Link et. al.'s (2016) concept of digital interactive surfaces that augment traditional physical setups with the use of three devices (glasses, gameboard, wand). The Glasses deliver a 110-degree Field-of-view (FOV) Head Tracking (HT) 8-megapixel infrared camera which can be used to detect motion as well as the position of the board and the wand. The glasses use this in conjunction with an 8-megapixel infrared programmable

Tangible Tracking (TT) Camera to detect objects and integrate them with virtual projections (Tilt Five, 2022). The gameboard is a spherical retroreflector, which returns the projected images from the glasses directly back to the wearer's eyes. The wand is then used to interact with the virtual elements of the device. The wand's position and movement are tracked in 3D space in relation to the wearer's glasses and gameboard (Tilt Five 2022).

These devices demonstrate the consumer availability of MR headsets and further their growth into the TTRPG market. This serves as an indicator that development within this space is worthwhile for the exploration of emerging ways we can interact with our TTRPGs.



## Conclusion

This review has highlighted what is required for immersion to be implemented effectively in mixed reality environments. At its core, White's (2014) perspective on the phenomenological engagement required for immersion to occur is plausible, but fails to explore the physical forms of technology that assist in the engagement of immersion. Mixed Reality has then been shown to be a potentially great solution to increase immersive engagement with games by virtue of the fact that it combines virtual elements within reality that are shown to to a depth of cognitive engagement with digital engagement that led to successful immersion.

## Ideas Explored in this Thesis

The ideas from this Literature and precedent review are further explored in the later chapters. By defining immersion and understanding that debate within immersion being facilitated through technological means is vibrant it seems important to provide further context and give it a definition for the purposes of Mixed reality gaming for tabletop roleplaying games. This will be particularly explored in the encounter element of D&D where I feel the element of immersion is low and could be elevated through technology while the narrative role playing element works as it is. This concept applies to defining mixed reality too. By contextualising the space within TTRPGs it became apparent that the MR precedents discussed create an immersion of the senses and led to further engagement. Interacting with a tactical environment and using the senses in collaboration with a digital engagement led me to believe these are key experiences of successful gameplay immersion in MR by the refining this into the context of Dungeons & Dragons It informed the survey questions asked and the potential of design choices. Exploring commercial MR devices gave a platform for this experience to be built upon.

# Chapter

03

## 03

### Survey Methodology

To address objective 1b (Investigate player enjoyability, engagement and immersive experience with TTRPGs, Digital aids and MR Devices through an online survey. Explore which features they prefer to be presented in analogue format and which digitally) an anonymous online survey was constructed around concepts explored in the literature review and other designs in the same space. The survey used convenience sampling targeted at New Zealand online D&D Facebook groups. A total of 67 participants responded. The survey was delivered using Qualtrics; most questions were answered using a multi-choice matrix. The survey asked players about their experiences with D&D including how much they enjoyed playing it and how immersive they found the experience. They were then asked about their experience with digital tools, and what features they would like to be presented digitally (as opposed to in analogue form) in an MR TTRPG experience. The survey results were collated, analysed, and presented as graphs to guide the design choices made for objective 2b (test the prototypes to see how they affect Players' engagement and immersion and the overall enjoyability of the game by observing their interaction with the MR experience and conducting post-game interviews focused on their interactions with the prototypes.)

### Prototyping methodology

To address objective 2a (Design a series of Mixed-Reality prototypes that assist with playing TTRPGs) I adopted Frayling's (1994) Research through Design process. This process aims to generate knowledge by designing innovative prototypes, and then, evaluating them by conducting various experiments in order to answer the research question. Through this methodology the prototype MR D&D toolset was designed, tested, and further iterations were produced until the best possible solution to my question was found.

## Playtest methodology

Initially to address objective 2c (Evaluate the results to create the desired package of enjoyable MR elements for the TTRPG). I planned to create a cohesive package for a fully realised MR experience that would run synchronously with a D&D combat encounter. However, due to a combination of Covid disruptions and technical issues that emerged during the iterative design phase, I instead decided to use playtests to obtain general feedback on the experience of combining the headset with tabletop play.

## 04

### Survey Overview

To understand the enjoyable, immersive experiences of playing D&D, I undertook a quantitative and qualitative survey of New Zealand- based players over the age of 18 with a mix of responses from players and Dungeon Masters. The initial question asked in the survey was “What do you enjoy about the gameplay within Dungeons & Dragons?” The response options for this question were:

- Narrative Immersion
- Combat Encounter
- Non-Combat Encounters
- Creating Characters
- Playing with Miniatures
- Socialising
- Number Crunching
- Non-Player Character Interaction
- Roleplay

# Enjoyability

Participants were asked to indicate their level of enjoyment for each of the options listed above by choosing from the following five options:

- Not Enjoyable
- Not Very Enjoyable
- Indifferent
- Enjoyable
- Very Enjoyable

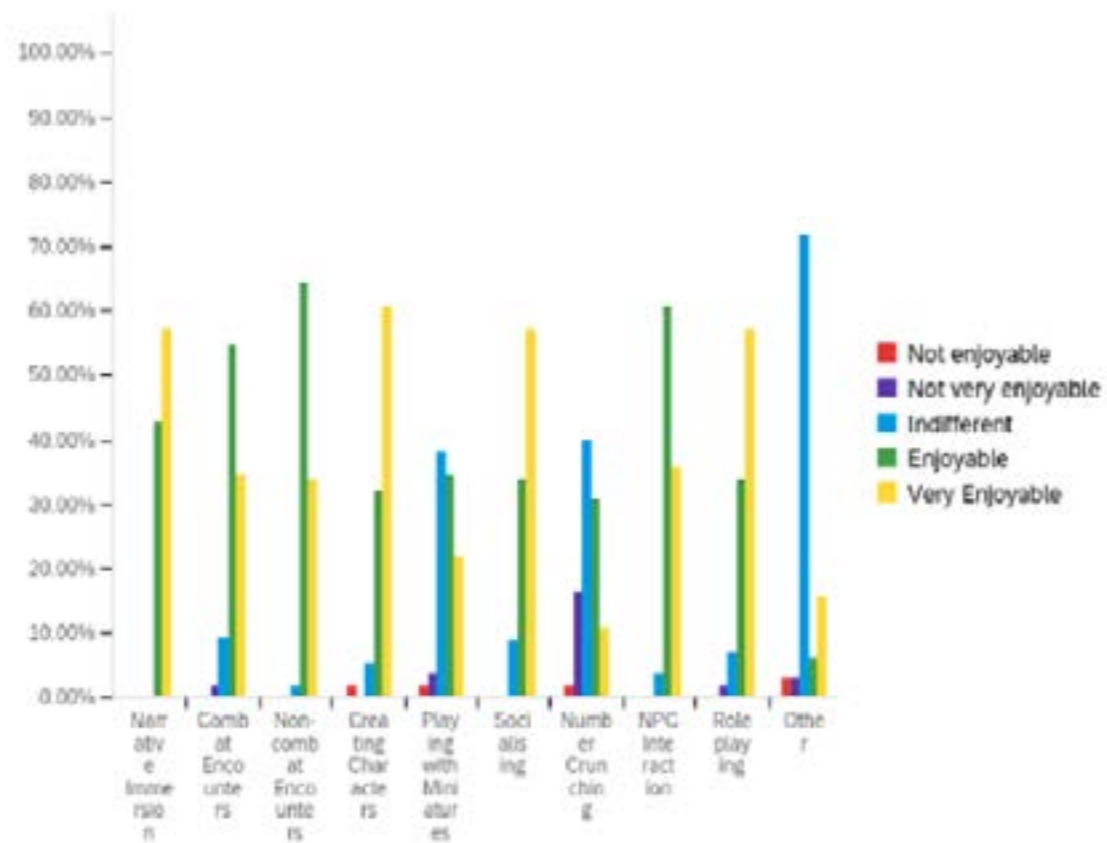


Figure 1. Enjoyability Graph

# Immersion

The next question in the survey presented the same previous options but asked "What helps you to be immersed in the experience of Dungeons & Dragons?" The survey response options were:

- Not Immersive
- Not Very Immersive
- Indifferent
- Immersive
- Very Immersive

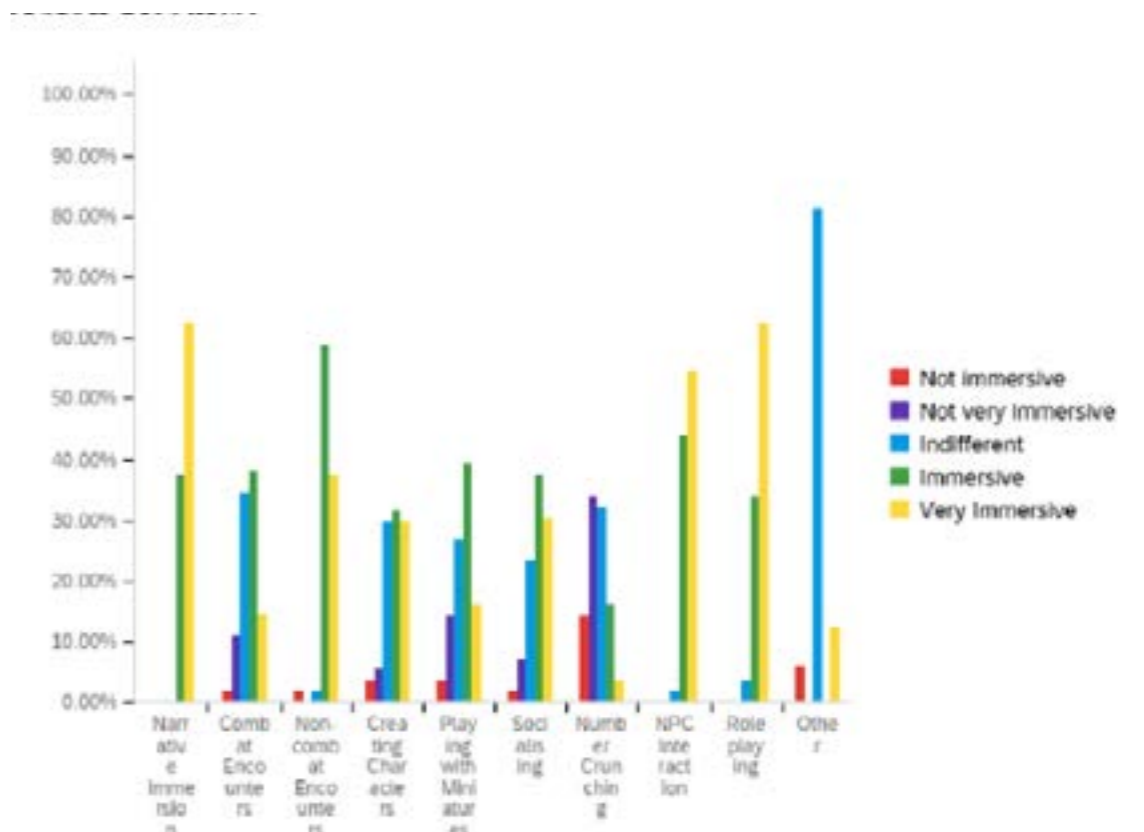


Figure 2. Immersion Graph

## Digital vs Analogue

The next question asked the respondents which features of Dungeons & Dragons they would prefer to be presented digitally or in analogue format. The features listed included:

- Rolling Dice
- Bookkeeping
- Character Creation
- Character Sheet
- Encounter Information
- Gameboard
- Miniatures
- Props
- Rulebooks W
- Other

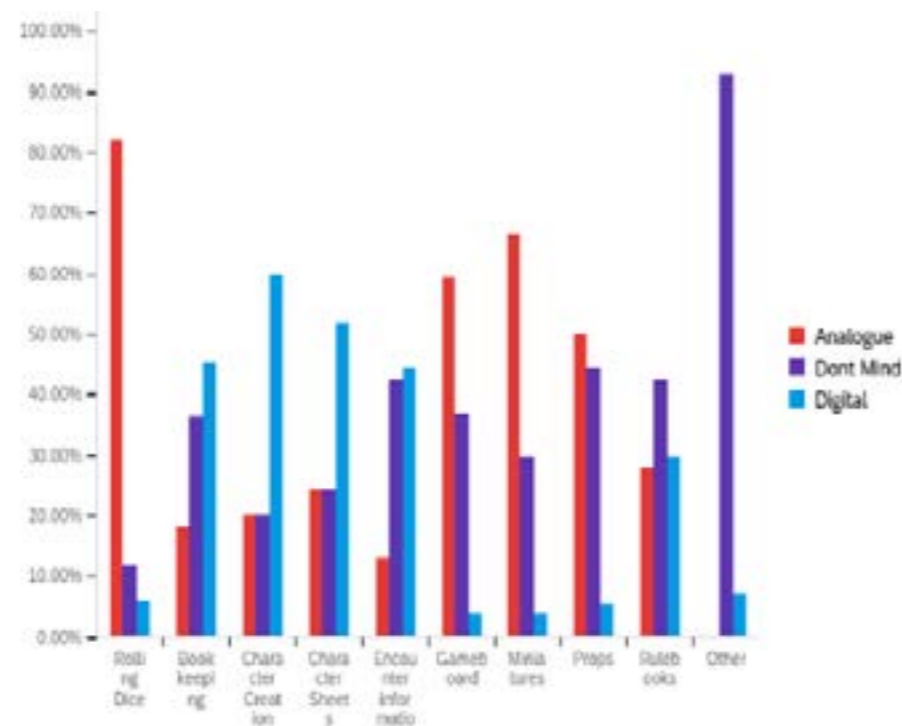


Figure 3. Digital vs Analogue Graph

## Digital Tabletop Preference

The next item in the survey asked players which digital tools they use to play Dungeons & Dragons and why they chose that option. The options for digital tools were:

- Astral
- D&D Beyond
- Fantasy Grounds
- Foundry VTT
- Owlbear Rodeo
- Roll20
- Tabletop Simulator
- Talespire
- Other

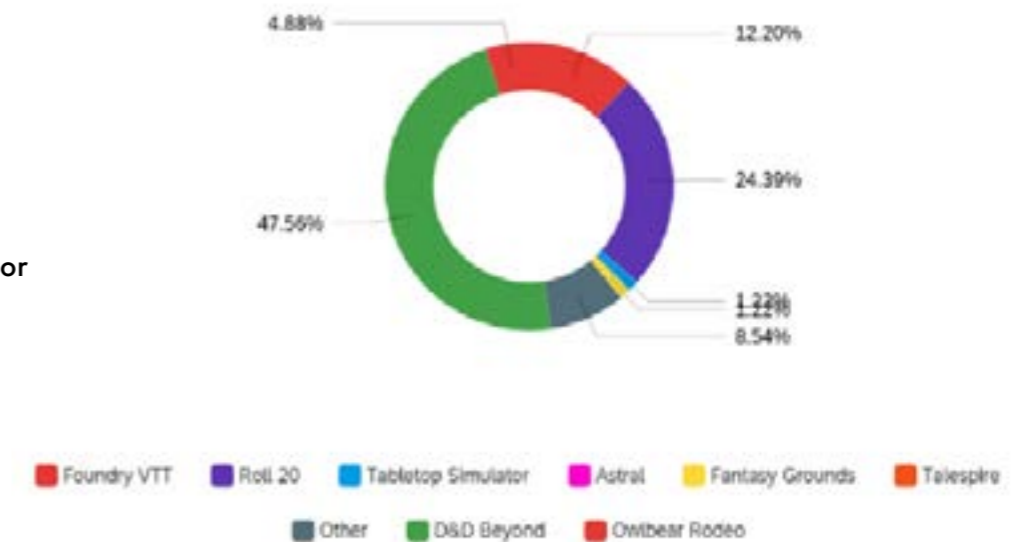


Figure 4. Digital Tabletop Preference Graph

## What would you like from MR?

The next question in the survey asked respondents which features they would like to see included within the MR virtual D&D experience. The question provided ten response options:

- Advanced Automation
- AI Assistance
- D&D Beyond Integration
- Easily Shareable Maps
- Streamlined Bookkeeping
- Streamlined Combat
- Virtual Environments
- Visuals Aids for Status Effect
- Visual Effects (VFX)
- Other

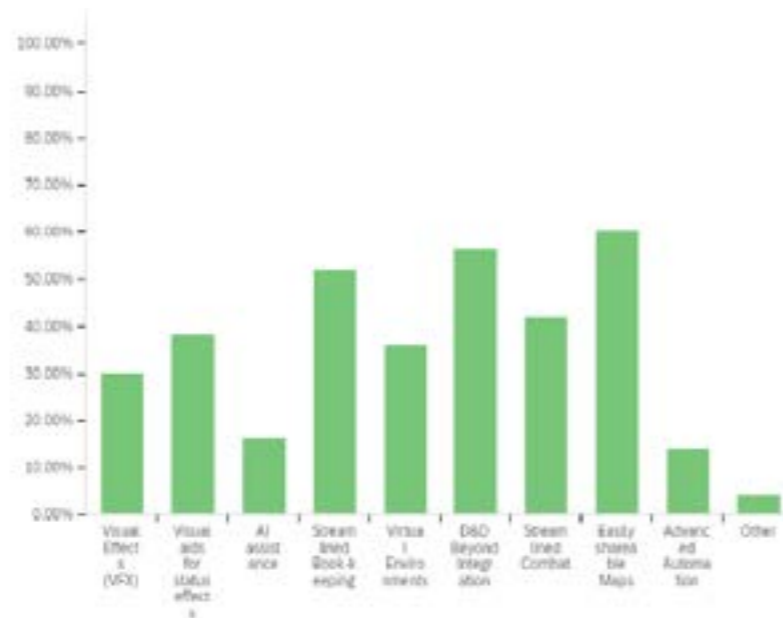


Figure 5. Desired MR Features

## Survey Conclusion

The survey findings indicate that the respondents found all the social aspects of the game very enjoyable (Narrative Immersion, Roleplaying, Socialising and Non-Player Character (NPC) Interaction), while they found Number Crunching the least enjoyable feature. It was also clear that players found these social elements equally immersive and Number Crunching equally non-immersive. Bookkeeping elements such as Rulebooks, Character information, Character creation and Encounter information were shown to be cumbersome parts of D&D to keep track of with most respondents preferring them to be digital elements of the game. On the other hand, there was a strong preference amongst the respondents for physical elements such as Miniatures, Props (player handouts, images, sounds, objects etc.), the Gameboard and Rolling Dice to be presented as an analogue experience. The respondents also expressed a strong preference for streamlining the cumbersome aspects of the game in an MR D&D experience.



# Chapter 05

## 05

The MR D&D initially- planned package was first designed based on what I considered to be key aspects of the respondents' survey results. From the findings, it seems particularly important to maintain in-person player social interaction. The survey results also highlighted that streamlined Bookkeeping needed to be a key feature of an MR experience, and that Miniatures, Props, the Gameboard and Rolling Dice needed to work in unison with the headset as a tangible experience.

Because streamlining all features of D&D for use within MR is beyond the scope of the thesis, I decided making a traditional Combat Encounter central to the experience would allow me to incorporate and streamline common trends of the survey (Number Crunching, Bookkeeping and the Creation of easily shareable maps) and to integrate tangible interaction such as Rolling Dice, Miniatures and Props in one cohesive MR package. These elements are all a consistent feature of Combat Encounters which could act as a proof of concept for the inclusion of these features in other aspects of D&D.

## Iterative Steps

The device chosen to build the MR-TTRPG experience for was the Microsoft HoloLens 2 headset (Fig 6 & Fig 7). This device was selected because of its unique capabilities that allow the user to interact with their physical environment freely in conjunction with the virtual environment without the distraction of a screen . The Microsoft HoloLens 2 also has cameras that can be programmed to track physical objects manipulated by the player. Technically this solves a key problem of incorporating physical tangibility within a virtual environment. The device also has the capability to be used in conjunction with other HoloLens headsets, allowing for a shared, multiplayer, social experience. The most important feature of this experience is the social experience (as suggested by players in the survey who saw the social aspect of sitting around a table with others as an important feature). These factors combined with the fact they are also readily available in the VUW School of Design for student use made it the best option. Unfortunately, because the Microsoft HoloLens2 is a relatively new device that is not commercially available yet, online documentation and tutorials beyond the official content were scarce. This represented an additional challenge in the design and development process.

## Designing the Prototype

The videogame development engine Unity was used to create the MR-TTRPG experience. I decided to use Unity because HoloLens has a dedicated toolkit that can be integrated within Unity. I was also already familiar with the Unity engine, which made it the best tool to work with. The first problem that needed to be overcome was finding a way to combine digital and tangible assets, for instance by combining easily shareable virtual maps with physical miniatures. It was essential that tactile feedback remained, allowing players to have a sense of physical interaction with their analogue and digital assets.

Two methods of interaction that allow for some form of physical feedback are Quick Response (QR) tracking (Microsoft, 2022), and Vuforia Image tracking (Vuforia, 2022). Each of these systems is described below.

### **Quick Response (QR) tracking**

The HoloLens 2 has the ability to detect QR in the environment around the headset, establishing a coordinate system at each code's real-world location. It can also render holograms in the same location on multiple devices to create a shared experience.

However, an effective option using QR tracking requires the use of QR imagery which does not allow the option to use custom imagery options to use custom imagery options to augment 3D objects e.g, a gameboard, D&D playing cards.

### **Vuforia Image Tracking (see Fig 8)**

Vuforia Image Tracking utilises the headsets' forward facing camera to capture Image Targets. Image Targets represent images that the Vuforia Engine can detect and track. The Engine detects and tracks the image by comparing extracted natural features from the camera image against a known target resource database. Once the Image Target is detected, the Vuforia Engine will track the image and augment the content. As with QR tracking, Vuforia Image Tracking can also render holograms in the same location on multiple devices to create a shared experience. This option allows players to upload imagery of their content quickly and effectively to the database to act as a tracking point for digital assets.

Though this method is fine for the purposes of tracking playing cards there are inconsistencies with the quality of the tracking. Digital models tend to stutter and jump slightly therefore it is not viable for larger scale objects that are strictly static in nature

in nature such as the Gameboard. Because of this issue I was only able to use Vuforia Image Tracking for the purposes of miniatures rather than the Gameboard.

The option to image track was a critical feature of my prototype since it provided a means of enabling players to interact physically with miniatures and other tangible objects. This was identified after it became quickly apparent that projecting a virtual environment through the headset's display resulted in blocking off a visual of the physical environment within the framing of said asset; in this case, it resulted in blocking off any visual of the player's miniature (see Fig 9) Because the miniature base (playing card) acts as a tracking point for Vuforia Image Tracking, players can physically interact with the card miniature base while the digital model persists on top of the card and digital environment. This indicates that any digital map environment can work in unison with the projected miniature which resolves the issue of players needing to be able to interact with tangible miniatures without the obstruction of view of the holographic map.

### **Multiplayer Interaction (see Fig 10)**

As previously mentioned, a solution was also needed to track large shared digital environments such as Encounter Maps without using QR or Image tracking. Departing

from these options meant the shared experience created through visualising the same physical Image Tracking needed to be achieved through other means. After some reflection, two workable solutions became apparent: workable solutions became apparent: Networking and Azure Spatial anchors.

When using the videogame development engine Unity, players can set up Photon Networking which is a service that allows users to connect multiple headsets in a shared experience (see Fig 10). Once multiple headsets are networked in this way, players can set up their own environment locally without needing to interact with and align their experience to the same gameboard. Photon Networking also allows for several individual instances of the same experience. This means that a player can move a miniature with an Image track in their instance and the same object will move in another player's instance. While viable, this feature partially detracts from the key social aspect of the experience. When this approach is adopted players are no longer sharing the same experience and interacting with one another directly. Yet, social interaction was a key point of preference in the player survey. Consequently, Photon Networking was ruled out as a viable option for this project. However, personal online instances does open up paths for a MR TTRPG experience from home in this covid environment.

Azure Spatial Anchors is a spatially aware application that allows AR devices to designate precise points of interest, called Spatial anchors, within the user's physical

The primary advantages of Azure Spatial Anchors are twofold. The first is that the application makes it possible for users to participate in multi-user experiences. "Azure Spatial Anchors makes it easy for people in the same place to participate in multi-user mixed reality applications. For example, two people can start a game of mixed reality chess by placing a virtual chess board on a table. Then, by pointing their device at the table, they can view and interact with the virtual chess board together" (Microsoft, 2022). In this circumstance, players can interact with a MR gameboard. The second advantage is that players' virtual content can persist in the same location even after they have stopped using it within their session. In contrast to Photon Networking, Azure Spatial Anchors allows for users to interact with the same digital environment in unison.

During the process of developing the MR toolset some critical issues were raised during the project. The first issue relates to the process of uploading the coordinates of the virtual environment to the Azure service. When using this toolset, a player can place the digital environment they set up prior to the session aligned with their physical table.

The player would then have the option of uploading the coordinates of their virtual environment either locally to the headset or online. If, while playing, the digital environment becomes misaligned or accidentally moves, the player can select 'Find Azure Anchor' and the digital environment will snap back into the location of the original coordinates. As these coordinates can be uploaded online, they can then, in theory, be downloaded by other headsets running the same application. This would then, in theory, allow all headsets to interact with the same digital environment precisely. However, during the process of implementing the anchors it became apparent to developers that there was an issue with uploading the coordinates online. Subsequently, it was confirmed on the support documentation that this was an active issue of the software, and not local. This issue disallowed the use of the coordinate upload feature which meant that a live shared experience was not viable. Instead, each headset needed to manually place each environment, so they were as aligned as possible. Because it is almost impossible to align the digital environments manually, this unfortunately resulted in the experience remaining purely local since no other solution was viable for a complete shared, social experience. Because of these significant technical issues, a full encounter could not be played during playtesting. Instead, I used these opportunities to obtain more general feedback on the local experience of features such as easily sharable maps, streamlined information unique to each desired circumstance and tangible interaction with miniatures.

# Playtesting

To address objective 2b (Test the prototypes to see how they affect Players' engagement and immersion and the, overall, enjoyability of the game by observing their interaction with the MR experience and conducting post-game interviews focused on their interactions with the prototypes) ran two playtests with three HoloLens headsets. Ideally would have liked to use more than three, but I was limited in the resources available to me. Through convenience sampling, I gathered eight other players who playtested the MR experience in two different sessions taking turns with the three headsets.. These playtests provided positive and negative feedback, and informed my thinking in terms of immersion, engagement, potential iteration, and future pathways for the technology.

## **Playtest 1: (see Fig 11)**

The playtest was structured according to the following format. Players took part in a group with 2 other participants in a classroom on Te Herenga Waka–Victoria University of Wellington's Te Aro School of Architecture and Design campus, lasting approximately 2-4 hours. Players were asked to interact with the local experience created for a D&D combat encounter while wearing a Microsoft HoloLens 2 headset. At this stage the prototype tested the functionality and effectiveness of shareable maps and tracked cards. Following the game, I led a discussion on what worked, what could be

improved and, what could be included in future iterations. I recorded this discussion to inform future design pathways.

To begin the discussion, I asked a series of open questions (see Appendix 2) and invited participants to respond. In the following account of the discussion, the participants have been labelled P1-P4 The first question asked was:

How do you find the MR 3D space experience in comparison to regular D&D? Is there something you see as an advantage about the MR experience?

Players commented that it gave the Gamemaster (GM) a lot more freedom to meaningfully set up encounters. I then explained to the players that I had originally set out to make a toolbox of presets such as DM tools, encounter tools and narrative tools after my survey results had indicated the value of streamlining the experience by reducing use of large quantities of DM and Player information (e.g encounter information, rules, etc.) and making use of the space to show the essential interactive information with the use of quickly presentable presets. 3 responded:

Yes like this experience, If I am going to be in a MR scenario I need to interact with stuff or it's not worth it otherwise I am just looking at something that's kind of buggy but obviously, the technology is not there yet. Interacting with it makes me feel like OOH we are playing a game.

then elaborated on P3's saying: " I think it is best to focus on simplicity (commenting on the visual environment). I can be a bit overwhelmed at times with the headset. It needs to be simple enough so that most people can pick it up to avoid frustration". P3 further commented: "If I wanted to sit down and play D&D with mixed elements, I would want it to be all one type of element i.e, entirely digital, or entirely physical. I find mixing quite disorienting as a result of the quality of visuals within the headset". 4 agreed but commented that they did not mind interacting with a digital environment.

Next, I asked the participants if the fidelity of the models (the headsets were not overly powerful so the environment needed to be simple) and the low resolution of the headset were detrimental to the experience. Players agreed, saying that they thought the experience needed to be simpler commented that when it came to Bookkeeping, people preferred the digital experience. The following comments were then made:

of having the information available to you in 3D space or physical space, which would you prefer?

P2: I like the idea of streamlined Bookkeeping in 3D space. Having a physical book seems less practical to find necessary information but having searchable and easily accessible information seems better.

P4: I think it is more struggle than it is worth if some information was kept physical and some was kept digital.

P2: [agrees] ... it would be impractical with the current resolution so reading would be a challenge.

P3: It would be easier to have the information set in meaningful places around the 3D environment as gesturing to find information because gesturing is annoying.

Researcher: Do you think it would be more engaging if the information was available and integrated with the 3D environment?

Participants agreed.

P4: For combat I think it would be easier to interact with the encounter with a controller, as the way it is done right now seems a bit fiddly.

I then commented on the other design precedent — the 'Tilt 5' —that uses a remote-type controller to interact with the board. Participants thought this was a great solution which would make the experience less busy and reported that the buttons would also streamline the process. P3 also commented - "It is also good to take into consideration that there are 4 people trying to pinch and pull at things". However, unfortunately the 'Tilt 5' was not available at the time of the development process.

Subsequently, P1 shifted the discussion onto long-distance play:

P1: What I really love with augmented reality is that you can play this over long distances. Say I could be at home, and I want to physically play with you guys, but I cannot. Then if we all had the same augmented reality then I could be there rather than a purely digital experience such as online tabletops and less digital than VR. That is more immersive for me.

P3: I would like to interact with my own experience individually in your own rooms, but you could see others' movements.

P4: The biggest gain from this experience is the physical social immersion gained that VR doesn't offer but also being able to offer streamlined elements and interactable features.

From this playtest it became apparent that the environment was too complex and disorientating for the quality of visual detail that the HoloLens 2 was able to produce. Relevant information that is not easily accessible (such as encounter information, player sheets etc.) needed to be implemented for each encounter map to take advantage of the 3D space offered by the HoloLens. Multiple encounter scenarios also needed to be created to demonstrate the advantage of providing access to readily accessible information (set up by the GM) tailored to each scenario, thereby eliminating the need for players to search through books for this information. The idea of at-home play through online networking became apparent as a potential pathway for COVID-impacted situations.



With that feedback in mind, I developed the design by simplifying the 3D encounter maps so that they would run more smoothly on the device. I then introduced streamlined information to test the impact of providing easy access to accessible information. After I had made these modifications, the GM was then able to open another map as a separate application on the HoloLens to quickly switch between encounters and access important information relevant to that encounter.

**Playtest 2:** (See Fig 12)

The second playtest followed the same format as the first playtest, but the new prototype provided streamlined information organised accessibly in 3D space. In the report of our discussion below, participants have again been assigned a number, this time P5 to 7.

The participants reported finding the presence of relevant information very helpful and commented that this made the experience streamlined, although at times information was difficult to read as a result of the headsets' visual quality.

P5 commented that the experience was easy to set up and helped keep the flow of play simple but found the device's inconsistency in tracking and technical limitations

frustrating. Clearly, the interface was clunky and unstable. P6 inquired whether online connectivity and individual areas of play (as mentioned previously) were more technically achievable, which might present a possible solution to tracking and anchor issues.

Researcher: Individual online instances are more technically achievable but, at the same time, they detract from the shared experience. By taking away the shared Gameboard you also replace the traditional D&D shared experience with a new experience beyond simply enhancing the traditional experience. However, this suggestion does open up alternative ideas for modifying the MR D&D Toolset for at-home play.

At this point, P3 commented:

My immediate thought is to holographically have the world of the game made present. I'm so used to using paper and pencil with character sheets and the information, so that is more normal for me. But a lot of people use D&D Beyond so a whole new digital device is not a huge issue. Being able to see the room. This setup and getting down and looking up close at the encounter is far greater

detail and with relevant information offers more than a traditional encounter.  
That is the initial attraction.

This comment highlighted the fact that D&D has a wide range of audiences with diverse expectations and needs, as noted in the initial survey. This realisation makes it complicated to design a game/app that will appeal to all groups.

# Chapter

# 06



## Summary

The Literature and precedent review sort to further explore a debate of definitions and use of technology within immersion. It was important to provide further context and give it a definition for the purposes of Mixed reality gaming for tabletop roleplaying games. By also contextualising MR within the space within TTRPGs it became apparent that the MR precedents discussed created an immersion of the senses that led to further engagement. Interacting with a tactical environment and using the senses in collaboration with a digital engagement led me to believe these are key experiences of successful gameplay immersion in MR by the refining this into the context of Dungeons & Dragons. It later informed the survey questions asked and the potential of design choices. Exploring commercial MR devices gave a platform for this experience to be built upon. The methodologies further elaborated on what was found within the literature and precedent review. The survey was constructed around concepts explored and other designs in the same space. The findings illustrate areas of focus that needed to be addressed for the player experience to be seamless, immersive and enjoyable.

The Prototyping and playtesting showed the HoloLens 2 has important potential as a development tool specifically in its application to the MR-TTRPG experience. Integral features of the HoloLens, such as its shared Spatial anchors (which are a central part of the headsets' purpose), were nonfunctional and beyond my control. As the design of the HoloLens 2 is not focused on achieving tactile and digital harmony, the development of these features is quite rudimentary. Nevertheless, the HoloLens 2 is a capable device that can create an MR experience that enhances aspects of D&D. The tactility of the experience is appealing, but the methods adopted to provide a mix of digital and analogue interaction are not sophisticated enough at this stage to deliver a seamless experience. Regardless, the HoloLens 2 has the ability to deliver a more streamlined experience through its provision of a digital 3D space which makes encounter information easily accessible. Easily accessible maps are another strength of the device. (As an unintended outcome of the project, I was able to incorporate virtual environments in the form of models). Yet from the data obtained, it is unclear if these MR features provide a more immersive experience than the traditional D&D experience. However, they certainly streamline the gameplay experience within 3D space, which represents an improvement on existing digital D&D applications quite apart from the relative weaknesses and strengths of the device in the context of MR-TTRPG.

## **Implications, and Interpretation of Outcomes**

The data obtained from administering the survey was a major strength of the thesis. Utilising an MR Headset in the context of playing Dungeons and Dragons has received little research attention to date. The data provided in the survey responses and the playtest discussions can inform future iterations of MR within TTRPGS. The study findings were also highly informative from a technical point of view in that they highlighted the strengths and weaknesses of these technologies within the context of a TTRPG. Given the likely diversity of players' preferences, it is impossible to design tools that deliver what every D&D player wants. While the survey respondents indicated their appreciation of a wide range of features, responses varied within the population of respondents. Consequently, I was obliged to target the majority preference, and simplify the application. In future, the scope of designing for a cutting edge device would be made easier by using the Tilt 5. This device provides a dedicated development toolset for TTRPGs which would eliminate the technical challenges and limitations discovered with the HoloLens 2. Unfortunately the Tilt 5 was released during the prototype and playtesting stages of the thesis

## **Improvements & Extensions**

In order to gain a more comprehensive range of answers on the survey. I would need to gather a greater sample size and provide the ability for more qualitative survey responses. The results showed care must be taken to provide MR features that justify using the 3D space provided by the headset rather than redundant features. The survey and playtesting also discovered the massive potential for the streamlining of information and utilising 3D space and providing the player with detailed 3D environments that are easily interchangeable although the visual fidelity of the display is a limitation that needs to be kept in mind. These elements show value within a potentially more immersive MR experience. The playtest results show that online networking to create individual shared experiences is a potential solution to tracking issues and spatial anchor issues experienced with the HoloLens 2 and their application could be useful if seeking to provide a shared experience beyond the traditional Dungeons & Dragons experience. The COVID pandemic demonstrates a need for this.

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# Appendix: A

## Playtest 1 – Discussion Notes

Question 1: What appeals to you about “Mixed Reality D&D”

Question 2: Most people see D&D as a visual experience, they like visual aids but do not see it as a big part that is necessary, some just want a process to streamline it according to the initial survey. Some people do like visual FX. So, what kind of D&D player are you? Do you play for the role-playing, Combat or are you a materialistic player who likes props miniatures and visual engagement?

Participant 1 response: visuals and role-playing. I like the immersion of it. I am not too worried about the narrative. I am just purely interested about how into it I can get. I want to relate to it. Q

Question 3: How would you imagine these Mixed-Reality tools being used for narrative purposes as opposed to encounters

Participant 1 response: for a player who is shy when it comes to role-playing having visual aids such as animation and models can help describe a character’s personality

Question 4: Do you agree you would like to mitigate how many virtual elements you are interacting with to maintain as many analogue interactions as possible to experience the core experience but with the aid of visual enhancements

Participant 1 response: I think the overall experience would be better

digitally but with the mixed-reality technology currently probably not. Pen & paper is a more fluid experience. It can feel clunky trying to move image tracked elements and digital models.

Question 5: Part of my research is measuring immersion. In the sense of engrossment. (How engaging is) when you play Dota 2 for an extended period why are you so engrossed and how does this experience relate in that sense?

Participant 1 response: with the use of digital visual aids, I can easily focus on this. But when playing with pen & paper I am easily distracted. But visual aids easily grab your attention because they stand out so much. The visuals are in such contrast to what you will normally see. It is constantly grabbing your attention.

Question 6: Directed at Participant 2: How do you find the MR 3D space experience in comparison to regular D&D? Is there something you see as an advantage about the MR experience?

Participant 2 response: As a DM you have a lot more freedom to meaningfully set up encounters

Participant 3 in response to comments on Foundry VTT: That was fun because you could experience the same visuals at the same time, but you could also interact differently with it.

Questioner comment: this is best suited for encounters because it is more like a video game

All participants agreed

Participant 4 said it is more important for the experience to be consistent for everyone in an encounter for using encounter related actions.

Question 7: How do you see this experience as a potential useful use for narrative immersion

Participant 3 response: I do not see it being useful for narrative immersion.

Participant 4 response: It will be harder to implement in a narrative setting

Participant 3: Even though I am a visual learner I feel like focusing on the way someone tells me a story in comparison to the way they show me it. The theater performance is more engaging.

Participant 4 response: One thing that might be helpful for narrative use is having a backdrop that is consistent with the area around you. Not necessarily the characters but the physical environment around you (building on static images you can use to show environments in Digital tabletop apps)

Participant 2 response: That'd be quite difficult in AR because you can

only see that window in front of you in which you can see things and everything in your peripheral is just the regular room (this would be achievable with the development of the MR)

Questioner: Originally, I set out to make a toolbox of presets such as DM tools, encounter tools, narrative tools etc. The initial survey results for the digital space would be good for streamlining the experience (stripping down the use for pdf and making use of the space to show needed interactive information and with the use of quickly presentable presets. They didn't care so much about the visuals. They do like it, but it was not a huge necessity, but it is required to assemble preset encounters and tools in the 3D space.

Participant 3: yes, if I feel like I am going to be in a MR scenario I need to interact with stuff or it's not worth it otherwise I am just looking at something that's kind of buggy but obviously the technology is not quite there yet. Interacting with it makes me feel like OOH we are playing a game.

Questioner. VR is better for digital interaction because the tools are further developed. Whereas the MR headset allows for physical and digital interaction.

Participant 3: comments on virtual backdrops such as swamp with dead trees around the player Participant 3 does not think that is as accessible because not everyone has a huge room to play in.



Participant 4: I think it is best to focus on simplicity. I can be a bit overwhelmed at times with the headset. I also think it needs to be simple enough where most people can pick it up.to avoid frustration

Participant 3: If I wanted to sit down and play D&D with mixed elements, I would want it to be all one type of element I.e. entirely digital or entirely physical. I find the mixing quite disorienting. I'd find it amazing to just roll the dice virtually rather than flipping between them

Participant 4: I agree but I am also fine just pressing a button

Questioner: commenting on the fidelity of the models and the low resolution so things of focus need to be clear.

Participant 3: thinks the character sheet and written information could be physical but the other elements could be digital to reduce strain.

Participant 2: disagreed with the other and thought it'd be great to roll physically and then use the digital ability with said rolls. But the limitation of the headset detecting the dice roll is a hurdle.

Participant 4: thinks voice input could be a valid option (this would require voice training and seamless integration as this could get in the way)

Questioner comments on the collection of dice and that is a big part of the game so taking away that tangible object is a problem

Question 8: So, would you all agree when rolling dice, it should be an analogue experience?

Participant 3: Agrees

Participant 2: Agrees

Participant 2: also thinks if the main satisfaction out of playing the game is rolling the dice, then you should play an analogue game. But for me, if I was told you can play digitally then I do not personally mind that the dice are not in it. It would be cool if you could, but it is not the end of the world if the dice are not integrated

Participant 1: would like the digital elements projected onto the dice.

Participant 4: Thinks at the point you're missing the point of why people like dice.

Questioner comment: when it came to bookkeeping, people preferred the digital experience

Participant 3: that is from the point of view of a DM I think though I've never been able to flip through a physical book as a player

Questioner: So, if you had had the option of having the information available to you in 3D space or physical space which would you prefer?

Participant 2: Likes the idea of streamlined bookkeeping in 3D space. Having a physical book seems less practical to find necessary information but having searchable and easily accessible information seems better

Participant 4: thinks it is more struggle than it is worth if we are being consistent keeping the character sheets physical too

Participant 2: agrees and says now it would be impractical with the current resolution so reading would be a challenge

Participant 4: If you could connect to a keyboard that would be easier to keep notes.

Participant 3: that seems a lot easier because gesturing is annoying.

Question 9: When you play with me in a regular game I need to find a piece of information that becomes a 5-minute interlude do you find that quite annoying? Does it take you out of the experience?

Participant 2: thinks it does

Participant 4: think it does a little bit, but it is not like it ruins it

Participant 2 Yes it is part of it

Participant 3: No, it does not ruin it

Questioner: Do you think it would be more engaging if the information were there on request or available quite quickly and seamlessly

Participant 3: How would you do that?

Questioner: Say I needed to find the cover damage and how much damage I take in half cover from the book. I could either use a search command or a more streamlined interface. Do you think it'd be easier to ask the device, or the information could be there on the board already in front of you

Participant 3: Yes.

Participant 4: For combat I think it would be easier to interact with the encounter with a controller as the way it is done right now seems a bit fiddly.

Questioner comments on another design precedent that uses a remote-type controller to interact with the board. They could move the assets with the remote rather than their fingers (tracking seems too clunky at the moment a remote might be better) the clicking is tactile, and the rumble would give feedback for something such as dice or moving objects.

Participant 3: that would be cool

Participant 4: that would make it less busy, the buttons would also streamline the process

Questioner I quite like that and the idea of the movement working on a grid system

Participant 4: Yes, I think it would be better than pointing at things.

Participant 3: It is also good to take into consideration that there are 4 people trying to pinch and pull at things.

Questioner: that is why I wish the tracked cards worked better so you did not have to do that. (Remove the clunk and scrap it down to a tactile remote and minimal elements)

Participant 4: For me I am almost turning it into a video game

Questioner: Well, that is the formula I am following because encounters are best suited to that flow of play. I almost envisioned it as a Yu-Gi-Oh! Type experience where cards were involved.

Participant 3: That is how I imagined the experience interacting with cards.

Questioner I'd love to do that, but I feel like I am offering a new experience that is not building on the pre existing game which is what I set out to do. But elements could be taken to enhance the experience instead.

Participant 1: What I really love with augmented reality is that you could play this over long distances. Say I could be at home, and I want to

physically play with you guys but I cannot then if we all had the same augmented reality then I could be there rather than a purely digital experience such as online tabletops and less digital than VR. That is more immersive for me

Questioner: That works with one of my prototypes and one of my COVID ideas.

Participant 3: I would like to interact with my own more individually in your own rooms, but you could see others' movements.

Questioner: It could even be here so you had your own space in front of you in comparison to a shared board and you would have all the same live updates in front of you. So, you are still all socialising but you can interact more easily with your own space

Participant 4: the biggest benefit from this is the social immersion you gain from

Questioner discusses an interactive and game-type approach to character creation. That is something that is introducing a game-type element but it's not replacing the experience

Participant 4: The thing for me is that AR & VR has always been a bit fiddly

## **Playtest 2 – Discussion Notes**

P5 commented that the experience was easy to set up and helped keep the flow of play simple but found the device's inconsistency in tracking and technical limitations frustrating. Clearly, the interface was clunky and unstable. P6 inquired whether online connectivity and individual areas of play (as mentioned previously) were more technically achievable, which might present a possible solution to tracking and anchor issues.

Researcher: Individual online instances are more technically achievable but, at the same time, they detract from the shared experience. By taking away the shared Gameboard you also replace the traditional D&D shared experience with a new experience beyond simply enhancing the traditional experience. However, this suggestion does open up alternative ideas for modifying the MR D&D Toolset for at-home play.

P2 My immediate thought is to holographically have the world of the game made present. I'm so used to using paper and pencil with character sheets and the information, so that is more normal for me. But a lot of people use D&D Beyond so a whole new digital device is not a huge issue. Being able to see the room. This setup and getting down and looking up close at the encounter in far greater detail and with relevant information offers more than a traditional encounter. That is the initial attraction

# Appendix: B

Figure 6. The HoloLens 2



Figure 7. HoloLens Being Used



Figure 8. Vuforia Image tracking of minitatures



Figure 9. Visual of playing card blocked from the holographic object,



Figure 10. Sphere represents another user interacting with the environment



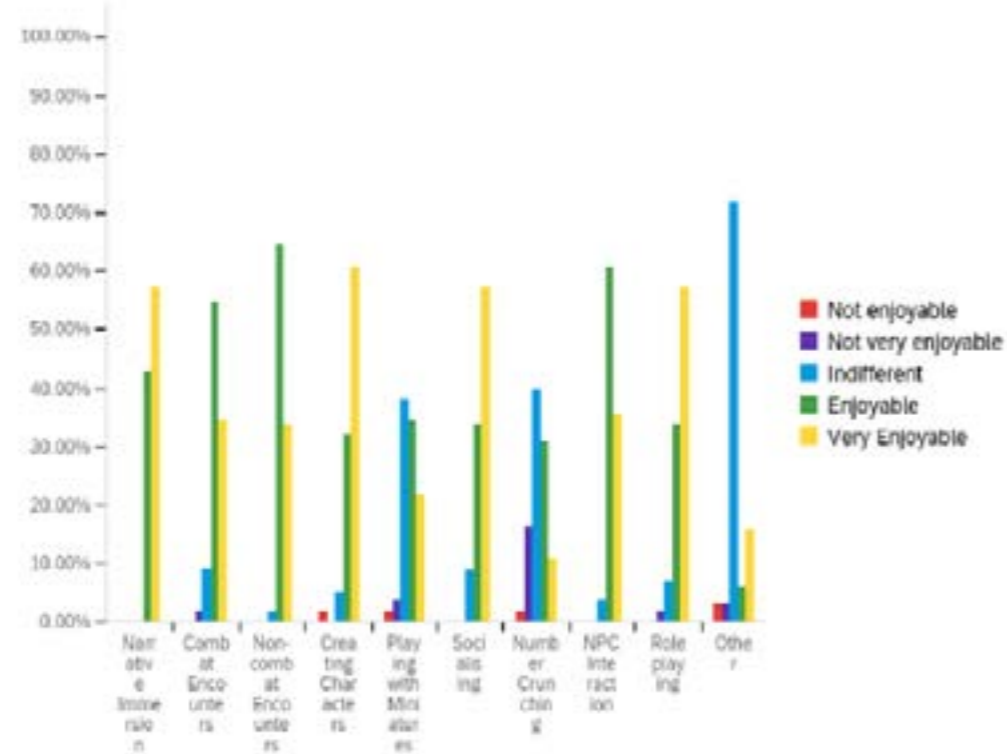
Figure 11. Play Environment 1



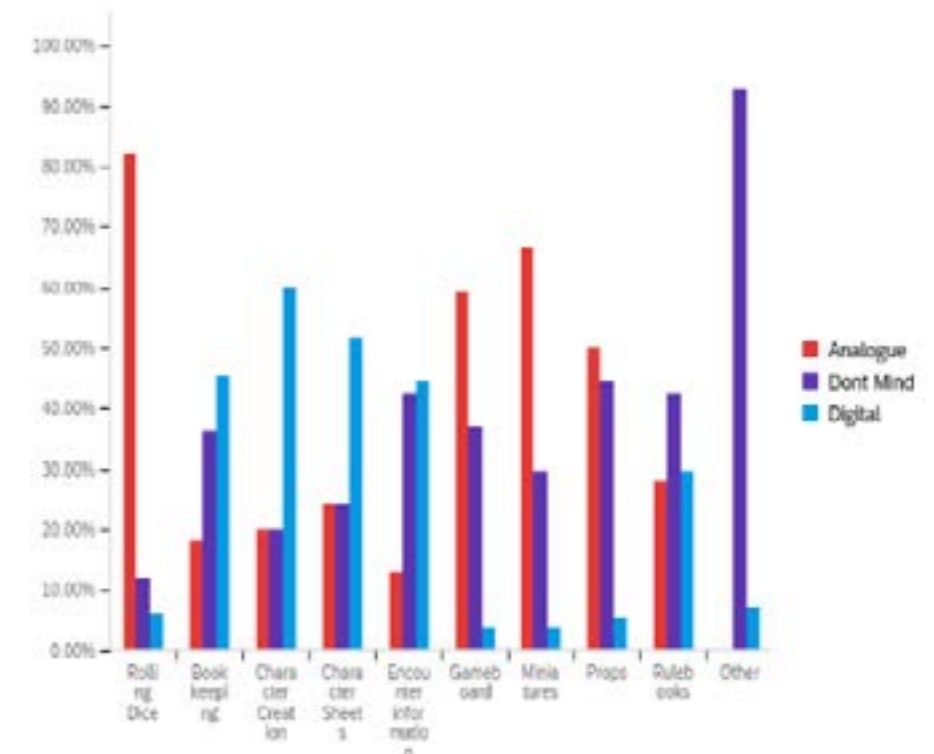
Figure 12. Play Environment with information in 3D Space



### Enjoyability Results:



### Digital vs Analogue Results:



### Immersion Results:

