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Plastic and the Sea Turtles

Eliciting Empathy
Through Virtual Reality

An exegesis presented in partial fulfilment of the requirements for the degree of Masters of Design at Massey University, Wellington, New Zealand.

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Abstract

This research project was prompted by the media reportage of a sea turtle harmed as a result of inhaling a plastic straw. It sets out to explore empathetic spatial narrative through the use of virtual reality (VR) as a method of environmental communication and activism. The exploration firstly involved research into storytelling, persuasion, empathy and immersive technologies as well as case study analysis of digital spatial design techniques used to persuade viewers about particular environmental or political topics. Through experiencing these case studies, and scuba diving, I was able to design a narrative that brought to life my research on plastic pollution in marine environments.

The result of the design process is a virtual reality experience. The design visualises data allowing participants to experience in a first-person perspective a scenario that is not typically accessible in our everyday lives. By taking on the perspective of a sea turtle, and by experiencing the effect of human waste on the environment, it is suggested that the participant is prompted to have a more compassionate understanding of the plight of non-human beings, such as sea turtles.

I argue that VR storytelling enables the participant to feel as though they are a part of the narrative. VR technology, namely, head-mounted displays deliver 360 degrees of immersive visuals, accompanied by surround sound to replace real-world senses, with the recreated and re-imagined. This simulated reality has the potential to prompt in participants an emotional response similar to experiencing the real. Through this simulation, VR creates a sense of presence and immersion within the digital environments, such as the marine environment created for this project.



Fig. 1. Sea Turtle with Straw up its Nostril, Costa Rica, 2015.

Table of Contents

3	Acknowledgements	37	Section 3: Prototype
5	Abstract	37	Design Process
9	Table of Contents	41	Narrative
		53	Making
11	Section 1: Introduction	73	Becoming a Scuba Diver
11	Context	81	Prototype
13	Research Aim		
15	Overview	87	Section 4: User Testing
		87	Recruitment
19	Section 2: Research	87	User Test
19	Immersive Technologies	99	Design Output
21	Perspective		
24	Empathy and Persuasion	110	Section 5: Conclusion
27	Is Virtual Reality the Ultimate Empathy Machine?	110	Findings
31	Storytelling in Virtual Reality	114	References
		120	List of Images
		124	Appendices

Section 1: Introduction

Context

In 2015 a video was uploaded to YouTube by marine biologist Christine Figgener and her research team who were studying sea turtles in Costa Rica (Sea Turtle Biologist). In the video, the research team pulled in an Olive Ridley Sea Turtle on to their boat and noticed what they initially thought was a parasite stuck in its nostril. But after removing the 'parasite', they realised what it was, a plastic straw. This video went viral and at the time of writing this has reached 38 million views (Sea Turtle Biologist). This video creates awareness of the impact that single-use plastics, in particular plastic straws, has on marine species and was a catalyst for bans on plastic straws globally (Parker).

It is estimated that 500 million straws are used daily in the US alone (Gibbins). Plastic straws are not the only single-use product receiving international bans. Plastic bags have received a lot of attention, leading to banning in multiple countries such as New Zealand, Bangladesh, China, Kenya, Macedonia and Rwanda (Parker). France has gone a step further and has declared an intention to ban plastic bags, plates, cups and utensils by 2020 (Parker).

Another example of a turtle affected by plastic waste is shown in Figure 2. The baby turtle had been found "washed up in Boca Raton, Florida, and died shortly after was found with 104 pieces of plastic in its stomach" (Elassar). After turtles hatch and make it to the ocean, they spend their first few weeks feeding on seaweed. Microplastics (small pieces of plastics, 1-5mm in size) latch on to the aquatic plants, which the baby turtles then eat (Elassar).

From the 1950s to 2015, humans have produced 7.8 billion tons of plastic, according to Our World Data (Ritchie and Roser). In 2015 alone, 381 million tons of plastic was produced, 146 million tons of that was used for packaging (Ritchie and Roser). The lifespan of plastic varies, depending on the type of plastic. It takes 20 years for a plastic bag to 'breakdown' or 'decompose', but it takes 500 years for a toothbrush (WWF, *The lifecycle of plastics*).

How is it that a plastic straw can end up in a turtle's nostril? According to World Wildlife Fund in the article *Stemming the tide of plastics in our oceans*;

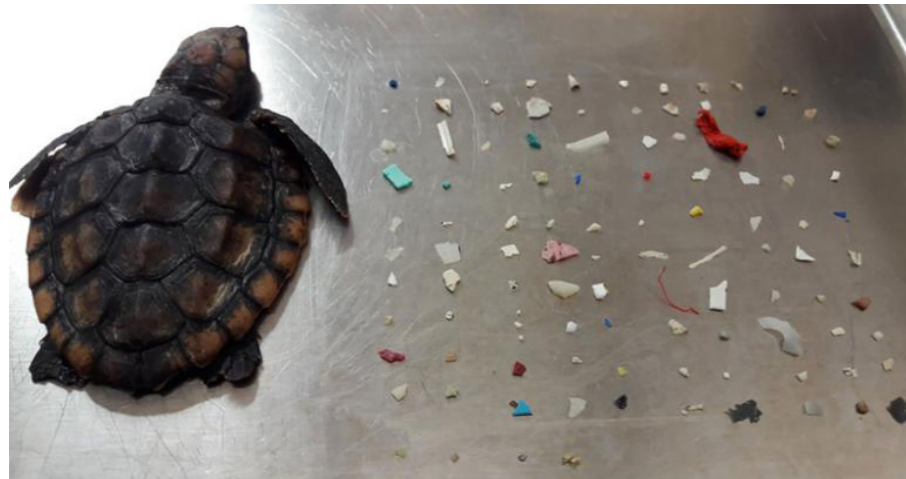


Fig. 2. Baby loggerhead sea turtle found dead in Florida with 104 pieces of plastic in its stomach, 2019.

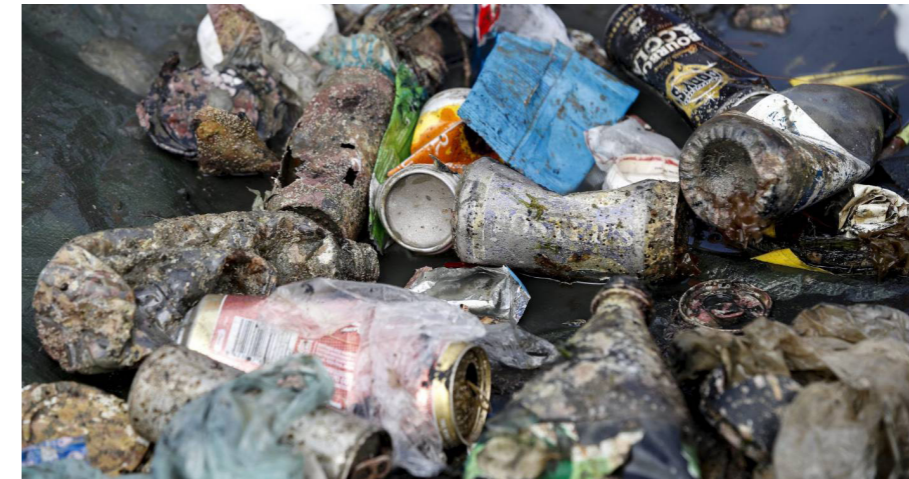


Fig. 3. Annual harbour clean up, Wellington, New Zealand, 2019.

8.8 Million Tons of plastic is entering the ocean every year, which is equivalent to “a garbage truck dumping a full load of trash into the ocean every minute”.

— WWF

Plastic enters the ocean through land and ocean-based sources. Land-based sources are often urban areas where plastic waste is either blown or washed away by rain into rivers leading to the ocean (Sheavly and Register 302). Other causes include illegal dumping, public littering and mismanaged waste, for example, uncovered dumpster or dumpsites (Sheavly and Register 302). Ocean-based sources include commercial fishing, “recreational boats and cruise ships” (Sheavly and Register

302). As Sheavly and Register explain; “some debris enters the water from accidental loss or system failure, while other debris comes from poor waste management practices, and illegal disposal” (302).

Sea Turtles, along with other marine species, are impacted by plastic pollution in aquatic environments through ingesting or becoming entangled in plastic; this leads to suffocation, lacerations, starvation, “decreased ability to catch food, and an inability to effectively avoid predators ... a false feeling of satiation, reduced fitness, and, potential toxicity caused by absorption of toxins from plastic debris” (Gall and Thompson 175). Six out of the seven species of sea turtles are classed as either critically endangered, endangered or vulnerable

(National Geographic, *Sea Turtles*), and all have recorded instances of dying by plastic entanglement or ingestion. In the case of the turtle with the straw in his nostril, the animal had eaten the straw, either mistaking it as food or swallowing it while eating (Sea Turtle Biologist). The turtle then tried to regurgitate it, but it got stuck in his nose.

The sea turtle is a symbol in my project for the impact plastic waste has on marine environments. Plastic pollution in aquatic environments is a global issue. Ghost Fishing New Zealand and Sustainable Coastlines are organisations that focus on clean-ups of local marine environments. In Wellington, New Zealand a crew of scuba divers and shore crew annually clean up the ocean floor of Wellington harbour. In January

2019 a team of 35 scuba divers and 40 helpers recovered from the harbour; “an Onzo bicycle, 45 road cones, old tyres, shopping trolleys, phones, clothing and general rubbish to items such as cans, bottles and plastic” shown in the Figure 3 (Long). The amount of waste that is pulled out of the harbour has decreased since they first started the annual clean-ups in 2013, where 40 tonnes of waste was recovered (Long).

Research Aim

My project explores the potential of immersive technologies to elicit empathy as a method of communicating the impact of concerning environmental issues. Specifically, the design aims to create awareness of plastic pollution in

marine environments and its impact on marine species. This research seeks to persuade its audience through pathos and logos (emotion and reason) to confront problems presented to them through spatial narratives and immersive storytelling. The research will investigate changes in behaviour and attitudes towards plastic consumption through user testing and surveys. The spatial narrative will take the participant on a journey through a simulated coral reef from the perspective of a sea turtle. The participant will witness the impact marine pollution has on the environment and the species that live there.

“**If individuals can be encouraged to take the perspective of nature and consider nature as a part of their self identities, they are likely to feel closer, empathic, and more immersed with nature, resulting in proenvironmental attitudes and behaviours.**”

— Ahn et al. 3

I chose virtual reality as my method of environmental communication because of its potential to elicit a sense of immersion and presence. Virtual reality has the potential to bring to life worlds and experiences that are difficult or impossible to do in our everyday lives, such as the act of closely observing a plastic-filled oceanic environment.

As Ahn et al. explain, the “general public fails to recognize environmental problems largely because” they can not see or witness the environmental impact; therefore individuals “perceive the risk of the disruption to be low because they rarely have the opportunity to personally see the consequences” (2). Virtual reality affords the possibility to adopt the perspective of nature.

How can immersive storytelling through Virtual Reality elicit empathy and persuade its participants into action?

Delivering statistics and information on environmental topics in an immersive story has the potential to provoke emotions and to persuade its audience to take action. As Shin explains, “the goal of VR storytelling is to tell a story that will stimulate emotions that will influence action” (64). Immersive storytelling has the potential to create a sense of presence and embodiment in the participant. Embodied experiences “create the sensation of personally having the VR experience” and participants perceive the avatar’s “actions as their own” (Shin 66). This leads participants to empathise with characters in the virtual environment as done in reality. I set out to explore embodied virtual reality experiences where the participant takes on the perspective of a non-human, to witness

environmental impacts, calling my participants to act on what they have seen.

In her article *Not a Film and Not an Empathy Machine* Professor Janet H. Murray states that “empathy is not something that automatically happens when a user puts on a headset” (Murray). And rather than viewing virtual reality as an ‘empathy machine’, which I will discuss more in-depth throughout this exegesis, Murray stresses that it is a storytelling tool that can create moments of compassion and understanding (Murray).

“**VR is not a film to be watched but a virtual space to be visited and navigated through.**”

— Murray

Each iteration of the VR experience, participants have the freedom to move through the space, to explore the marine environment, allowing for the protagonist within the narrative to encounter and make sense of the water world. John Bucher states, “storytelling in Virtual Reality is less about telling the viewer a story and more about letting the viewer discover the story” (7). Allowing participants to control their movement through the virtual space perhaps leads them to feel more involved in the narrative. It is this uncertainty that my research aims to explore utilising spatial design techniques, such as

lighting, sound and pathways, to help participants navigate through the virtual environment. Real-time storytelling leads the participant to discover more information as they explore the virtual environment. Bucher adds, “when telling real-time stories, the audience immediately begins searching for information that might be helpful to them in orienting themselves in the new world they have entered” (66). A sense of presence and immersion also leads to a deeper understanding of the digital environment and experience

The aim of my narrative is for the participant to explore the coral reef environment and the creatures that live there, and to then discover plastic waste and those who are impacted by it. The narrative will ask the participant how it feels to be in someone else’s shoes, so that they are encouraged to empathise with the marine species in the digital space who are suffering harm or death due to human impact.

Overview

This exegesis will discuss the methodologies used in designing my experience. My primary method is Virtual Reality, accompanied by processes of empathy, persuasion and storytelling. Virtual Reality is commonly referred to as not only an experience viewed through a head-mounted display

(referred throughout as 'HMD') but as experiences where we immerse ourselves into a moment or an object. For example, Ulrich explains, "every time we daydream, listen to the radio, watch the news, or talk on the phone, we experience some form of Virtual Reality. Any human-made representation of a reality that others can immerse themselves in, such as prose, paintings, photographs, movies, or video games, can be considered a type of virtual reality" (6). When discussing Virtual Reality throughout this text, I will be referring to immersive virtual simulations viewed through HMD's.

Head-mounted Displays (HMDs) can deliver 360 degrees of immersive visuals, accompanied with surround sound, haptics (touch), and in some cases scent-producing machines (with specialised equipment) to fully replace the real-world senses with the re-created and re-imagined (Ulrich 8). This leads to experiences in these simulated realities to feel real and provoke an emotional response. As Ulrich explains, "the more vivid a virtual world is, the more it feels like [an] actual experience, and the more directly it influences emotions" (9).

But is virtual reality a revolutionary medium for telling empathetic stories?

Sherman and Craig explain the four defining features of virtual reality as;

it is a communication medium, it can physically and mentally immerse its users, "provides synthetic sensory stimulation" and lastly, it is interactive (38). In Chris Milk's TedTalk, he describes VR as a machine, a communication tool in which stories can be told (Milk). We put a headset on, and we are transported into immersive virtual worlds, and "the more vivid and immersive a virtual world is, the more one's mind reacts as though it is an actual experience" (Ulrich 8). Milk states in his talk;

“**Through this machine we become more compassionate, we become more empathetic, and we become more connected. And ultimately, we become more human.**”

— Milk

Through my design process, I began with storyboarding several different narratives to visualise my research and statistics found on plastic pollution in marine environments. I then prototyped my narratives in Unreal Engine 4, shifting between both mediums of storyboarding and prototyping, to develop my narrative. I focused on how I was going to represent these statistics in my story spatially to ensure that my participants understood the experience. For this, I took inspiration from my case studies, which I will discuss throughout the exegesis. I also experienced scuba diving to receive a deeper

understanding of marine environments. It was imperative as part of my process to user test my VR experience to receive feedback from participants. User testing, in this instance, refers to participants experiencing my virtual reality prototype to receive feedback through questionnaires. I then responded to the feedback given, to develop the experience further, ensuring the goals of the experience was achieved. I will discuss my process of user testing more in-depth later in the exegesis.

Section 2: Research

Immersive Technologies

This section describes my investigations into other modes of immersive technologies, such as augmented and mixed realities, along with a more in-depth analysis of why I have chosen virtual reality as my method of environmental communication. Augmented Reality (AR), augments the physical environment, working as a digital overlay (often used in smartphone applications). Mixed Reality (MR) refers to the merging of both physical and digital aspects. MR is viewed through a head-mounted display that work like glasses as the viewer can still see the physical environment. The headsets have cameras that scan the room to create a mesh so the digital elements, like characters, can interact with the physical space appropriately, for example, in Weta Gameshop's new mixed reality experience for the Magic Leap headset, *Dr Grordbort's Invaders*, robots can jump onto coffee tables and hide behind couches.

Virtual reality has removed the frames of two-dimensional media and has allowed the viewer the ability to turn their head and look around (Bucher 1).

I have chosen VR as my method of communication because it has the potential for users to be fully immersed in an environment. Virtual reality "isolates users from their physical environment", replacing sensation given from their physical environment with a digital environment (Witmer and Singer 227). A virtual environment that successfully isolates a user from their physical environment will increase the sensation of immersion and presence. Immersion refers to how well the participant movements are responded to in the digital environment and how natural the experiences feel. In contrast, presence refers to the "psychological sense of 'being there'" (Markowitz et al. 2). As Witmer and Singer explain elements that affect immersion are "isolation from the physical environment, perception of self-inclusion in the VE, natural modes of interaction and control, and perception of self-movement" (227).



Fig. 4. A still from the video *The Indoor Generation*, (0:01).

Due to the isolation of the physical environment and participants feeling immersed and present in the digital environments leads VR to be a useful tool in education. As Markowitz et al. explains “learning in VR is possible because VR systems produce highly engaging experiences, which can lead to greater focus on the learning topic” (2). Virtual reality experiences that are successful in creating immersive and interactive experiences can feel natural, authentic and engaging. As Markowitz continues to state; “an immersive virtual experience with high levels of presence allows the individual to suspend any belief that the experience is mediated” (2).

As part of my research, I investigated other modes of communication, such as videos that communicate a particular political or environmental

issue. The Video, *The Indoor Generation*, uploaded to YouTube by Velux in 2018, is designed to create awareness of unhealthy homes and their impacts. As shown in Figure 4, the video is narrated by a young girl who starts by saying, “in 160 seconds, you will decide how this story ends” (Velux). In doing this, the statement grabs the viewers attention and involves them in the narrative of the video. In the next 160 seconds, the narrator discusses the behaviours of ‘the indoor generation’, delivering statistics on how this impacts our health. The video is successful because not only does it communicate and create awareness of an issue, but also offers solutions, which helps to prevent the viewer from feeling helpless and unwilling to act. The video also uses immersive visuals and cut



Fig. 5. A still from the video *His Epic Message Will Make You Want to Save the World*, (0:38).

scenes to enhance the information the narrator is discussing and grab the audience’s attention.

Similar to this is the video *His Epic Message Will Make You Want to Save the World* uploaded to YouTube by National Geographic. The video visually presents statistics to make a more significant impact when discussing impacts humans have on the planet. In doing so, the narrator clearly articulates the key discussion points. The video starts with hard-hitting statistics, and it concludes with a call to action. Like my experience, these videos are designed to persuade the viewer to act on the information presented to them. From them, I learnt strategies that I would test in a three-dimensional setting. As Ahn et al. explains “video delivers many

features of IVEs, though it is not interactive and does not allow the use of naturalistic movements to control events and objects within the mediated environment” (4).

Perspective

I have chosen the use of first-person perspective (FPP) in my design for its ability to allow the participant to feel more embodied into the character and to offer a more natural experience, of seeing the world through the turtle’s eyes. If the experience was seen through a third-person perspective, where the camera perspective was outside of the body of the turtle, the participant would not feel as though they were the turtle rather just in control of the turtle. This



Fig. 6. A still from the 360 VR interactive experience *Tree*, (1:21).



Fig. 7. A still from the 360 VR interactive experience *Tree*, (5:57).

affects the participant's immersion in the virtual environment and how they interact and are involved in the narrative. As Gorisse et al. explain, the use of first-person perspective induces "a sense of embodiment" and ownership towards "the virtual body" (1). First-person also enables the participant to easily navigate through the virtual environment, again deepening their sense of presence and immersion (Gorisse et al. 10).

Virtual reality and first-person perspective allows for natural and embodied experiences, where the participant can move freely through a virtual world — creating the opportunity to experience a coral reef through a sea turtle eyes, and to experience environmental issues,

such as the impact plastic waste has on marine species and environments. Through experiencing first-hand environmental impacts through first-person virtual reality experiences, creates more in-depth and empathetic understanding and therefore results in "proenvironmental attitudes and behaviours" (Ahn et al. 3).

When designing an experience where the participant is viewing a virtual world through the perspective of an animal, I have employed anthropomorphism to deepen the emotional connection between interactor and turtle. Harrison and Hall explain anthropomorphism as "the attribution of human characteristics to non-human animals, [which] is likely a byproduct of the ability to

draw upon one's own beliefs, feelings, intentions, and emotions, and apply the knowledge of these experiences to the understanding of the mental states of other species" (35). Utilising anthropomorphism in my experience will allow the user to empathise with the turtle and other characters within the space. Understanding the turtle's situations will offer reflective moments in the experience of the impact our waste causes.

Taking on the perspective of the turtle, moving like a turtle and interacting with the virtual environment as a turtle, allows for a deeper understanding of the perspectives of turtles and other marine species. Anthropomorphism is a "byproduct of empathy, [and] arguably

promotes the well-being of non-human animals, as it plays a role in maintaining our respect, care, and compassion for other species" (Harrison and Hall 46). Anthropomorphism is often used when discussing animal welfare and ethics. It is a critical part of my design because I am discussing the well-being of marine species as a way to persuade my participants and elicit empathy (Harrison and Hall 46).

An example of an interactive virtual reality experience that uses a first-person perspective from a non-human is *Tree* directed by Milica Zec and Winslow Porter. The experience is designed to create awareness of deforestation and its impacts on climate change as part of the VR for Impact initiative for developing

virtual reality experiences to promote sustainable development (vrforimpact.com). In this experience, we take the perspective of a tree that grows from a seedling underground into a giant tree that can see right over the forest. This experience is highly immersive; the use of surround sounds, atmosphere and lighting enhance the experience. The experience ends on an event designed to shock the embodied visitor and to create empathy towards the forest. This event begins with the sounds of trucks and men shouting in the distance. We then see fire. The fire gets closer and closer until it reaches the roots of our 'body' (Figure 7). The perspective then changes, we can see ourselves as the camera zooms out of the scene, changing our role in the experience from actor to observer. The switch in perspective is powerful, as we still feel connected to our virtual body (as it is still reacting to our movement). At the end of the experience, the screen fades to black, and we receive information on the project and where we can donate.

Empathy and Persuasion

Empathy is defined as the ability to understand and share another's feelings and emotions. Archer and Finger define empathy into three categories: cognitive and affective empathy and empathetic

response (16). Cognitive empathy is defined as "perception of another person's emotional state", affective empathy as "sharing another person's emotional state, emotional convergence" and empathetic responding is defined as "responding to another's feelings" (Archer and Finger 16). I have chosen empathy to define the outcome of my experience rather than sympathy, pity or compassion because of the more active process it implies (Shelton and Rogers 376). Empathy implies a deeper connection and understanding of characters emotions in the experience or situation, and "motivates us to do for others" (Shelton and Rogers 366). It can be used as a tool to persuade viewers into action, and change attitudes and behaviours towards a particular subject.

Schoeller et al. explain "affective empathy may lead to both positive and negative effects" (1). If a participant is transported into a highly distressing or stressful situation, this may lead to the participant shutting down and not responding to the information presented to them (Schoeller et al. 1). But as Scholler et al. continue discussing "the negative effects of affective empathy can be trained, limited, and avoided", and participants can "learn to transform empathic distress into healthy and prosocial reactions" (1).

Aristotle's rhetoric "has traditionally been discussed in the context of written works

or spoken words" (Ulrich 9). Rhetoric is divided into three categories: pathos, logos and ethos. Ethos is defined as the credibility of the speaker, trust and influence and logos is logic and reason. Pathos is often described as emotion, as Shelton and Rogers explain the fear and empathy persuasive appeals are both labelled as pathos (366). In my proposed virtual reality experience, I am utilising pathos and logos as part of my strategy to provoke an emotional, empathetic response in my participant, to persuade them to confront the problems presented to them. The experience will display statistics within my experience through text, as my method of logos, to communicate to the participant the devastating impact plastic has on marine species and environments. Along with creating awareness of the amount of waste is entering the ocean and the impact it has, the experience will deliver solutions and actions, the participants can personally undertake to help decrease their impact.

Ulrich explains, "virtual reality is a new, complex form of communication, and as in any other medium of communication, we can use rhetoric in virtual reality to convey arguments and change how individuals view the real world" (5). Immersive technology, such as virtual reality gives the audience a vivid experience. (Ulrich 6). Ulrich continues by stating;

The complex and subtle rhetoric of virtual reality functions primarily through this emotional impact and gives creators of virtual worlds unparalleled influence over the minds of their users. Because virtual reality's immersive and customizable nature leaves users open to unconscious manipulation and behavioural change, I argue that we must learn to be aware of rhetorical mechanisms in the creation and consumption of virtual rhetoric (6).

In the VR documentary series called *This is Climate Change* directed by Danfung Dennis and Eric Strauss in 2018, each of the four episodes titled *Famine*, *Fire*, *Melting Ice* and *Feast* discuss a particular environmental issue around climate change. The use of VR allows participants to experience the impacts or causes of climate change first hand. Each use statistics and narration to communicate each topic. In *Feast*, the documentary is located in the Amazon forest in Brazil. The experience starts with a compelling statement presented as text on the screen, "the Amazon is the largest rainforest on earth. Its four hundred billion trees are called the lungs of the planet soaking up carbon emissions and slowing global warming. But the laws that once protected the Amazon are failing and illegal logging is on the rise." (Dennis and Strauss). Beautiful scenes of the Amazon then follow this. Travelling over top of the



Fig. 8. A still from the 360 short film *This is Climate Change: Feast*, (4:35).



Fig. 9. A still from the 360 short film *This is Climate Change: Melting Ice*, (3:23).

beautiful forest, we begin to hear chainsaws and trees falling.

The experience takes us to a logging company to witness the process of cutting and transporting trees. The use of VR makes us feel present and apart of these moments; the cutting down trees, the clearing of land, and processing the logs ready for transportation. After the experience discusses this process, it moves on to why this is happening; to make room for cattle ranches. The experience explains, shown in Figure 8, “Brazil loses the equivalent to two football fields of rainforest a minute” (Dennis and Stauss). The experience concludes with scenes from a butchery, with rows and rows of dead carcasses. Again like the VR experience *Tree*, these scenes are designed to shock the participant and to make awareness of the contribution the viewer has on the issues; the consumption of meat.

In the episode *Melting Ice*, the VR documentary discusses the issues caused by the loss of ice. The episode is located in Greenland, where they have been experiencing increasing temperatures. Again we are placed in the environment affected, standing next to glaciers as they crash into the ocean, hearing the loud snapping noises, and rushing rivers. In this episode, instead of having text to deliver statistics and information, a narrator is talking throughout the episode. As we look at

a giant river travelling through the ice he states (Figure 9); “anyone who has any doubts on what’s happening to the climate should see just how quickly the ice is melting and how fast the glaciers are moving” (Dennis and Stauss). Virtual reality has allowed, in this case, the audience to see first hand the impact caused by climate change.

Is Virtual Reality the Ultimate Empathy Machine?

In Chris Milk’s TedTalk titled *How virtual reality can create the ultimate empathy machine*, he discusses the power of being present and immersed into stories told through books and movies. But now, because of virtual reality, viewers can be physically transported into digital environments to explore and discover. He describes VR as a machine and a tool to tell empathetic stories.

In the virtual reality experience *Clouds Over Sidra* by Chris Milk, Gabo Arora and the United Nations 2015, transports us to Jordan to experience what it is like to live in the Za’atari refugee camp. Sidra, a twelve-year-old refugee girl, narrates the experience. The VR documentary is designed to create awareness of her situation and the 130,000 other Syrian



Fig. 10. A still from the 360-degree documentary *Clouds Over Sidra*, (1:52).



Fig. 11. A still from the 360-degree documentary *Clouds Over Sidra*, (6:44).

refugees in her camp. Sidra takes us through her temporary home, discussing her daily routine and how it differs from her life in Syria. We sit on her bedroom floor with her, the camera is lowered to her level, and she looks us in the eyes as she speaks. She explains to us that she doesn't want to be here anymore, that she would like to go home (Figure 11). The experience creates empathy and compassionate understanding towards Sidra and refugees that have been forced to leave their homes as a result of war. As discussed in the introduction Milk states that through experiencing these empathetic stories in VR we become more compassionate, connected, empathetic and therefore more human, with the potential to make a significant impact and change the world (Milk).

Virtual reality "is excellent at playing with our emotions" (Brewster). The audience feels like they are participating; they feel like they need to sit on the ground when the character in front of them does (Brewster). Participants experience scenarios with their own eyes, which is more memorable than viewing the same media through a two-dimensional medium. We respond to these stories seen in VR as done in reality. Therefore experiencing a documentary, like *Clouds Over Sidra* or an interactive experience like *Tree in VR*, in immersive environments that creates presence, we receive a deeper understanding of different perspectives and experiences.

Alsever argues in her article *Is virtual reality the ultimate empathy machine?*, in response to Chris Milk's TedTalk,

that empathy "is the wrong objective because it assumes too much about the power of visual immersion", rather we should ask, "what would the world be like if we could better understand each other?" (Alsever). But in these compelling, emotional experiences that connect us to those in the experience, we have compassionate understanding, and therefore empathy. These experiences are persuasive, sparking long-lasting change and educate audiences. Alsever continues by explaining that because the technology is highly immersive when displaying distressing imagery can result in negative responses. Alsever states; "dropping viewers into a violent experience that's too shocking or horrific might alienate them and make them not want to return or get involved" (Alsever).

In the VR experience, *This is Climate Change: Famine*, we are taken to Somalia in East Africa where dry weather has impacted many communities. The experience is narrated by multiple people, sharing different perspectives. When looking into the vast dry land (Figure 12) the narrator, a farmer explains, "when I was younger, all of this was green" (Dennis and Stauss). With the inability to grow food and feed their animals, the narrative explains that 400,000 people are malnourished and many, predominantly young children, are dying. Witnessing sick, malnourished children was extremely upsetting, and in the case of this experience, backs up Alsever's argument; scenes that are too shocking and hard to watch may result in a negative reaction.



Fig. 12. A still from the 360 short film *This is Climate Change: Famine*, (3:22).

As mentioned previously, Murray argues that we should not view VR as an 'empathy machine'. She explains "showing people in sad circumstances via a headset will not make them any more or less relatable than showing them on TV or in photos in a newspaper. In fact, some 2D still photos are worth 1000 VRs" (Murray). In the case of the short videos I discussed earlier, they are highly persuasive and informative. But she does go on to discuss "instead of overhyping the inherent empathy-value of VR documentary, we should look for the specific moments that point to the genuine promise of the medium in creating compassionate understanding, and build on those" (Murray).

The key affordances of VR is the ability to be interactive and to transport participants real or imaginary spaces, for example, to experience being a turtle in the ocean. Being present in these virtual reality stories leads to embodiment, engagement and empathy (Shin 66). Virtual reality experience where the user embodies a virtual avatar are more immersed and engaged in the digital environment. It makes us connect with not only our avatar but the environment. As Shin explains;

Future research should see immersion as a cognitive dimension alongside consciousness, awareness, understanding, empathizing,

embodying, and contextualizing, which helps the user understand the content and stories delivered. The concept of immersion not only takes into account the technological aspects of VR but also the emotional, motivational and cognitive processes involved in focusing engagement (71).

Storytelling in Virtual Reality

This section discusses techniques and strategies for designing immersive and interactive VR stories. When developing a narrative for virtual reality, deeper consideration is needed in comparison to traditional media such as text and film. The designer needs to consider; what is the role of the participant in the experience? What level of interaction does the participant have? How do they navigate through the digital environment? And how do these aspects contribute to or affect the overall narrative? As Shin explains,

“ VR is redefining the rules around narrative structure, character development, and storytelling. ”

— Shin 64

Shin continues by explaining, "VR He continues by explaining, "VR storytelling does not merely make users feel - it also changes who they are in the virtual space. Fully immersive VR can offer users a sense of embodiment, through which they see themselves as part of the VR environment" (Shin 68). Experiencing a moment is more immersive and memorable than watching a scene in a movie, "users feel they are present in VR; they are dropped right into a scene, as if they were part of the story" (Shin 65).

Murray explains when designing a virtual reality experience avoid the use of cut scenes or "edits that are not the result of voluntary and conscious movement on the part of the interactor" (Murray). Everything is centred around the embodied visitor; therefore, the focus is not on the camera frame, but the entire space the participant is inhabiting (Murray). She continues to explain the importance of only using sound that is directly apart of the environment and the participant; "please leave out anything that can be heard or seen that is not diegetically part of the virtual space that is the actual focus of your design. Everything the interactor sees or hears must be part of the space VR creates for them to inhabit. This means no voice-overs, no text overlays, no background music" (Murray). In the experience Tree, discussed earlier, does not use voice-overs, text or background music during

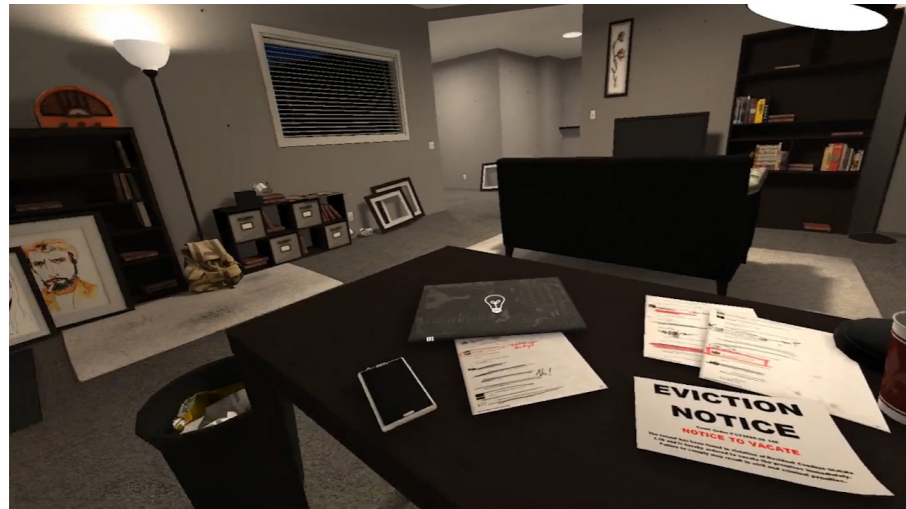


Fig. 13. A still from interactive virtual reality experience *Becoming Homeless*, (0:50).



Fig. 14. A still from interactive virtual reality experience *Becoming Homeless*, (2:18).

the experience. The viewer gathers information from the environment, sounds and movement in the digital experience. Audio can be used to grab the participants attention and lure them through the digital space. For example, the sound of trucks and men shouting is a cue for the participant to look up and see the fires burning in the distance.

The digital environment in my experience plays a significant role in storytelling as it visually communicates the environmental issue of plastic pollution in marine environments. Witmer and Singer state that, “an environment that contains a great deal of information to stimulate the senses should generate a strong sense of presence” (229). Involvement and immersion into a virtual environment are “necessary for experiencing presence”

(Witmer and Singer 227). When participants are immersed in a virtual environment, they experience presence and feel as though they are a part of the narrative. Witmer and Singer continue by stating, “perceiving oneself as moving inside a simulated environment or directly interacting with other entities in that environment will also increase one’s sense of being immersed” (227). Connecting my participants to their character (turtle), their involvement and understanding of the virtual environment and narrative they are in is enhanced.

Our role in setting up the potential narrative is to allow for moments of interactions and discovery (Bucher 12). Bucher explains “creators should leave space for a variety of potential experiences the user may have” (16). Allowing the

participant to have control in where they go in the narrative allows for individual experiences. Virtual reality is an “effective medium for interactive storytelling” (Shin 64). Interaction doesn’t need to be a big gesture; it can be very simple.

The interactive virtual reality experience *Becoming Homeless: A Human Experience*, was developed by Elise Ogle, Tobin Asher, Jeremy Bailenson in 2018 at Stanford University’s Virtual Human Interactive Lab. The seven-minute-long VR experience takes the viewer on a journey of becoming homeless. The experience is designed to create empathy and understanding of homeless people’s situations. Our journey starts by becoming aware of losing our job and not being able to afford rent. After being evicted from

our apartment, we spend our nights on public transport to keep warm. The narrative discusses that because of the increasing numbers of homeless people, shelters are full, and public transportation allows them to ride for free at night. This part of the experience was successful because you selected a person on the bus, and in their voice, they told the story of how they became homeless. The experience was engaging, created a sense of presence, and informed viewers on situations of homeless people. As Schutte and Stilinović explain “a sense of presence or engagement may facilitate feelings of connection with others and understanding of others’ perspectives” (709).

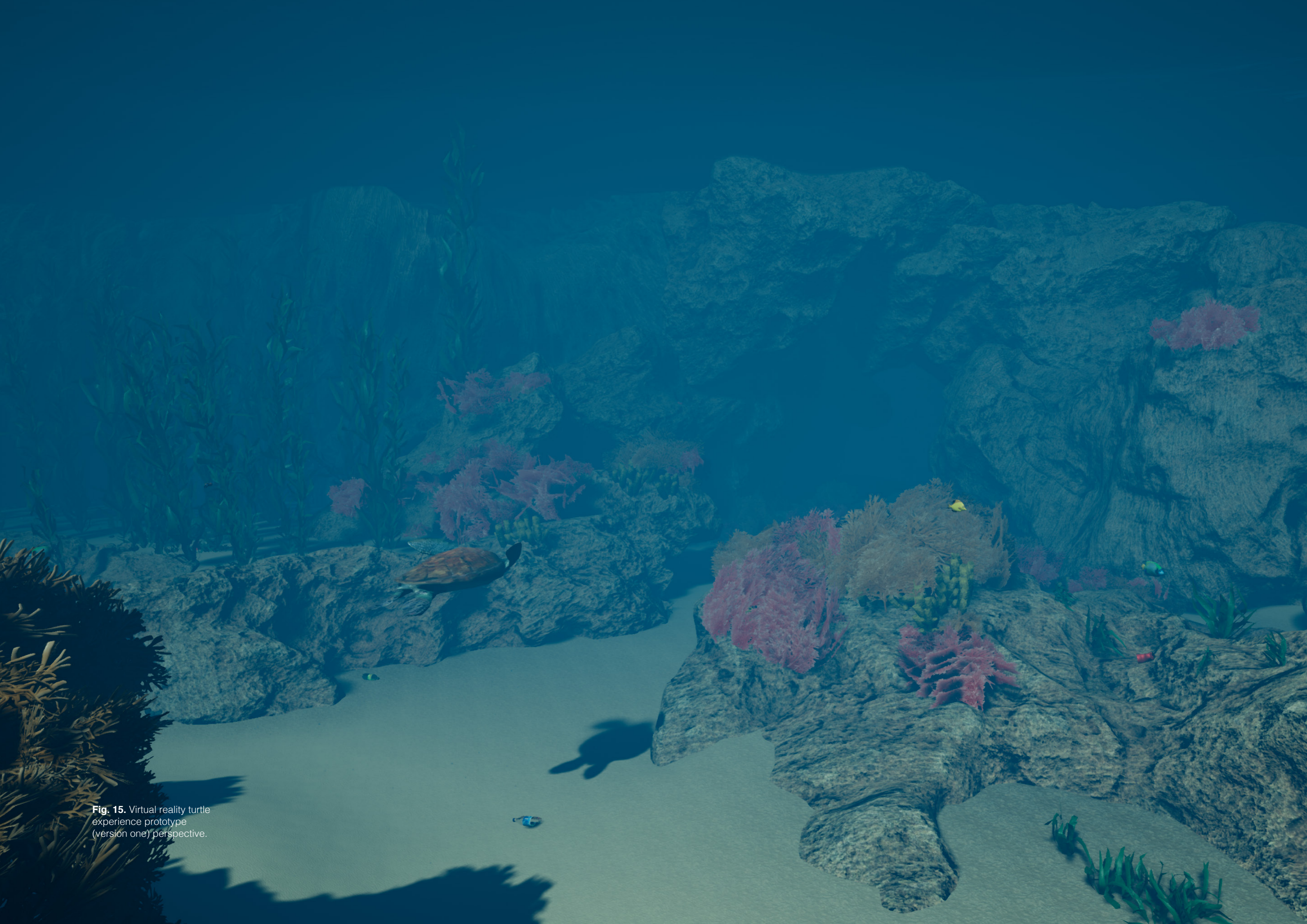


Fig. 15. Virtual reality turtle experience prototype (version one) perspective.

Section 3: Prototype

Design Process

The VR experience is designed for a broad audience as plastic pollution is contributed and affects everyone. The experience is directed towards an audience who are not aware of plastic pollution in marine environments or are interested in learning more about the topic. The proposed experience is designed to be exhibited in a museum or company that is related to marine wildlife. This is to situate the experience where it will reach its users and make an impact.

My design process began with researching into my methodology; communication of environmental issues through virtual reality and my chosen environmental topic. From my research, I gathered statistics that I wanted to visually communicate to my users; for example, how much waste is entering the ocean every minute. This was followed by visualising my narrative through; illustrating, storyboarding and mapping. Visualising my story was an essential part of my design process, and I often bounced between illustrating and making to develop my narrative. Once I had a narrative, I was happy with I began prototyping in Unreal Engine 4,

starting with the landscape and water. Once I had this base, I began placing in rocks to create spaces and pathways, which I then enhanced with foliage, particles and characters. I then moved on to the functionality of the experience; this included trigger boxes to launch my animations and text.

I invited people to test my experience to help me refine the digital environment and narrative. User testing allowed me to have a deeper understanding of my participant's perception of the experience and adjust the space accordingly. Another part of my design process was to experience being underwater in a marine environment. Going scuba diving allowed me to experience atmospheric qualities that I could then replicate in my digital space, for example, organic particles, lighting and sounds.

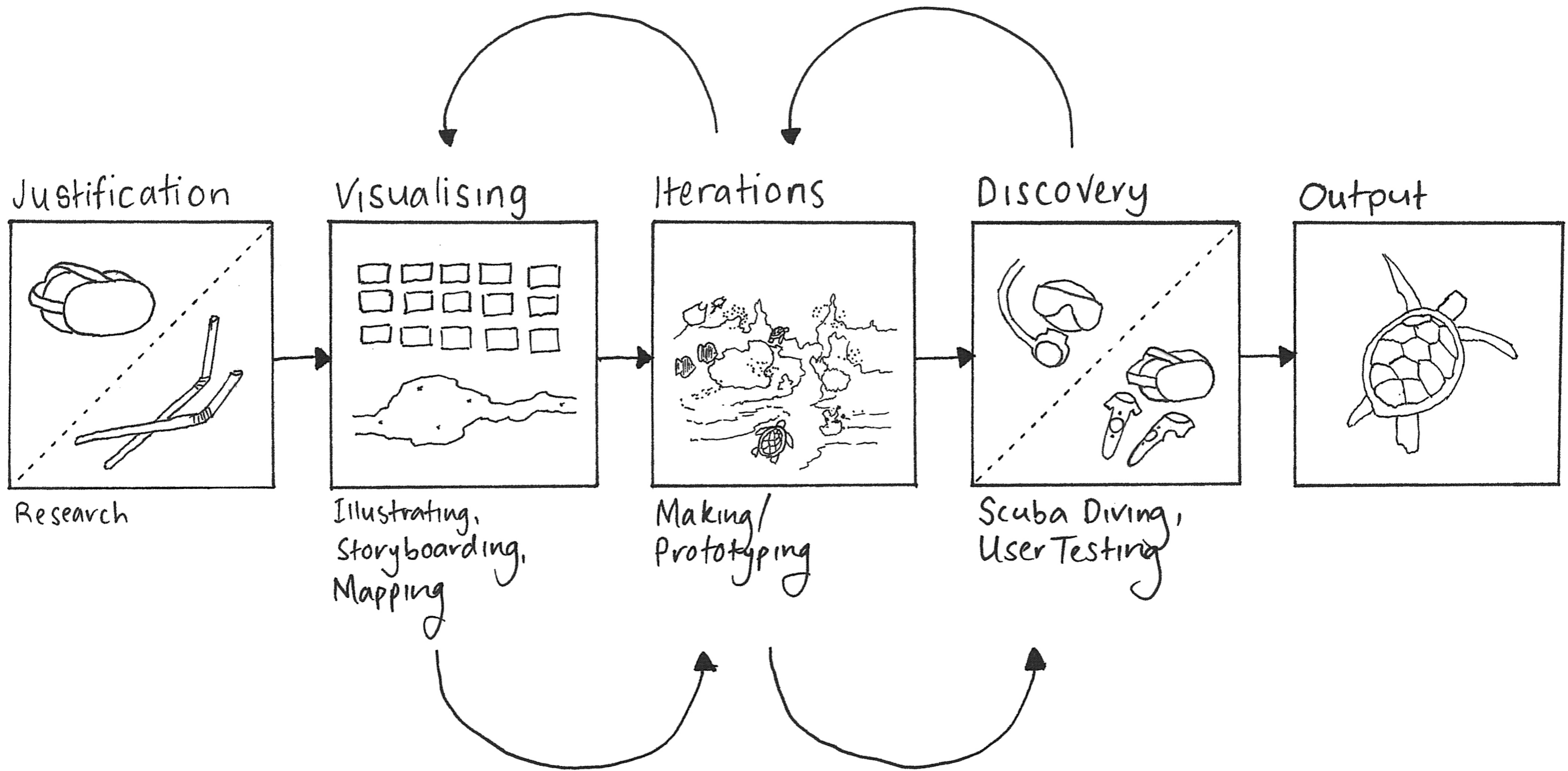


Fig. 16. Design process.

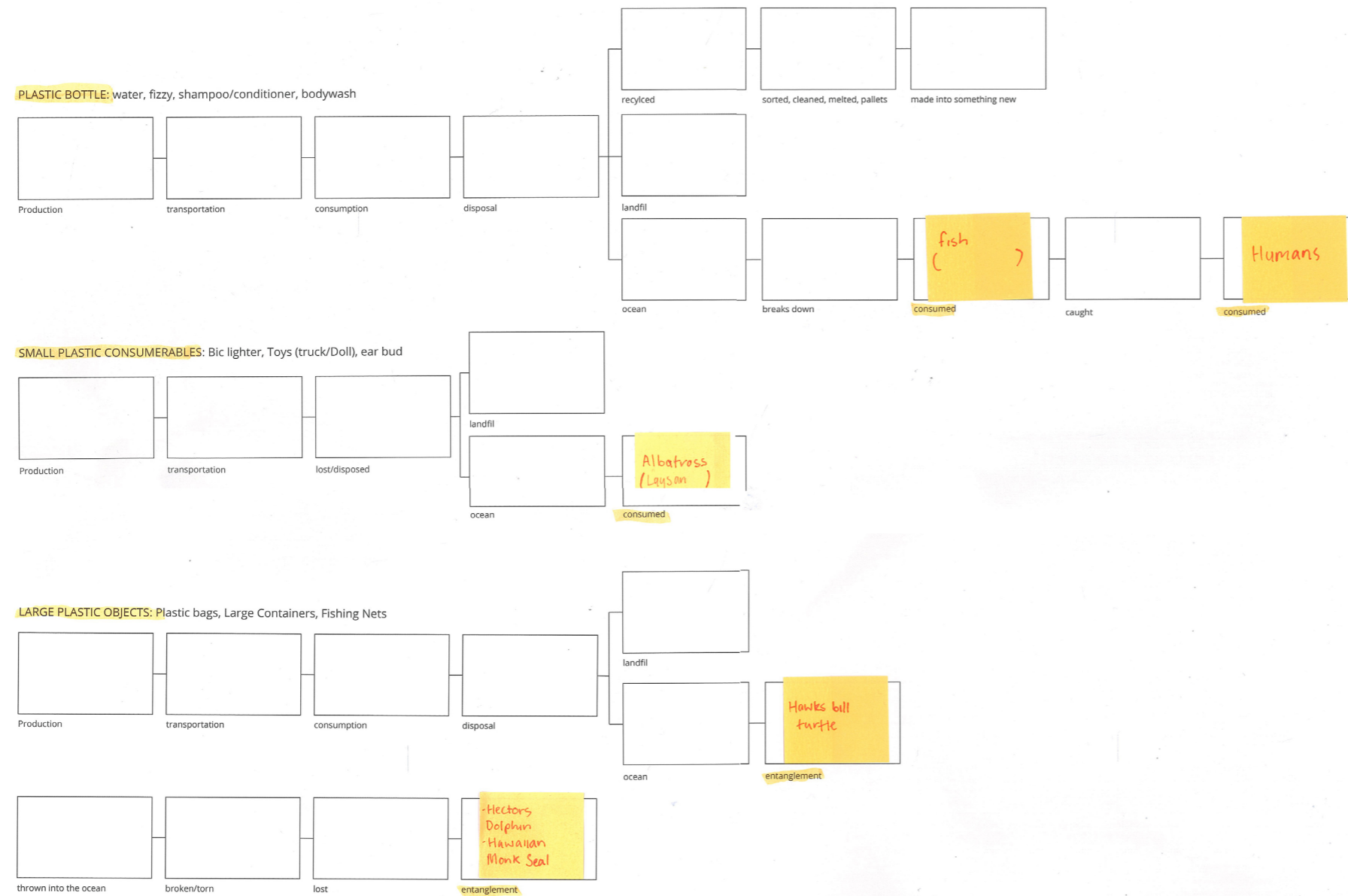


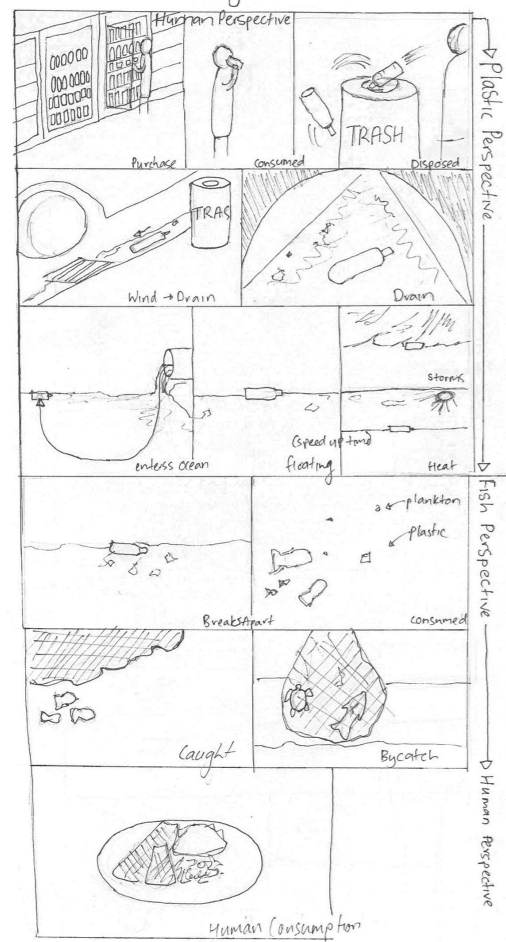
Fig. 17. Plastic journey map.

Narrative

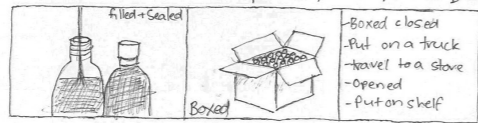
Plastic Journey Narrative

Storyboarding helped me visualise how I was going to deliver my statistics and research on plastic pollution in marine environments. Initially, I began by storyboarding an interactive narrative with multiple perspectives and storylines. The goal of having multiple perspectives was to tell a variety of stories to show the scale of the issue and to educate on the lifecycle of plastic. Shown in the plastic journey map (Figure 17), I had chosen the perspectives of plastic objects, to show their journey to the ocean, influenced by my research, which leads to encountering a marine animal. I mapped out how this narrative would look and the different storyline or pathways the participant could choose to go.

Plastics Journey (Bottle)



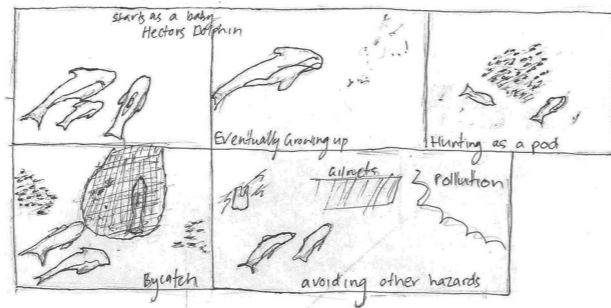
Plastic Production (Repeated for all plastic items)



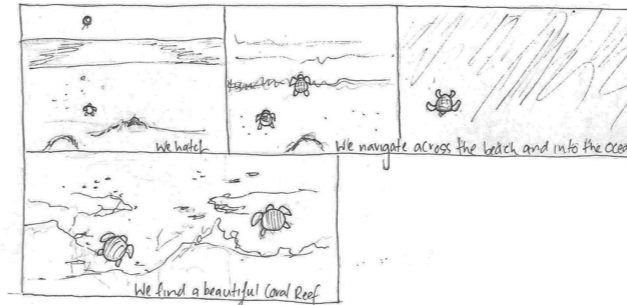
Albatross Perspective



Hector's Dolphin Perspective



Hawksbill Turtle Perspective



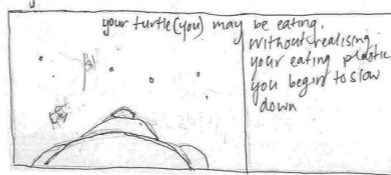
Plastic Bag Entanglement



Ghost Netting Entanglement



Ingestion



Multiple Perspective Narrative

After designing the plastics narrative, I developed a marine species narratives. By showing a variety of marine species perspectives, my goal was to show the significant impact plastic has on aquatic ecosystems. I wanted to represent the different types of species affected by plastic waste from fish, sea birds, turtles and marine mammals. I choose the perspectives of a fish, Hawksbill Turtle, Hector's Dolphin (native to New Zealand), and Laysan Albatross.

I continued developing this narrative, shown in Figure 19. I took inspiration from my case studies and started thinking of how the information was going to be delivered. In this storyboard, I planned on using voice-overs, to explain what was happening in each of the different narratives.

Fig. 18. Multiple perspectives storyboard (Narrative One).



Opening scene we see beautiful corals, a stingray swims overtop of us. We are swimming in amongst the corals and fish. We see another turtle. We start eating sea grass. "The ocean is important not only for marine species, but humans as well. Every organism plays a part in keeping the environment healthy."



Fish swimming close to the surface, which has plastic debris and plankton. The fish are eating the plankton and plastic. Then a "truck load" of plastic is dumped on top of the fish. "... but human waste is impacting marine environments... it is estimated that a truck load of plastic enters the ocean every minute..."



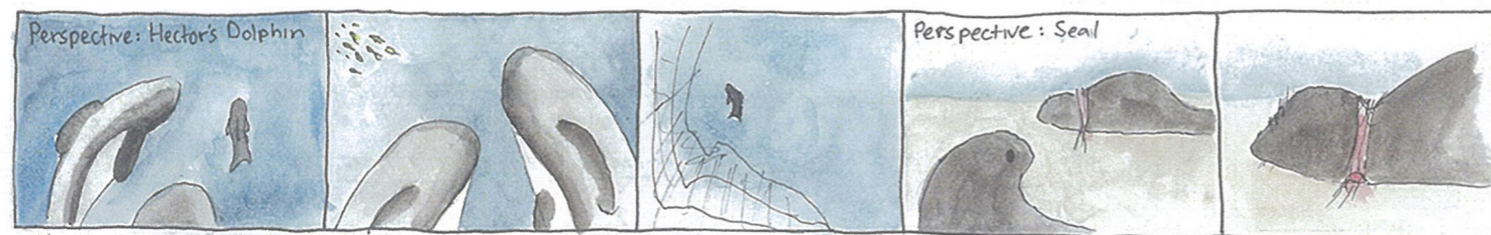
Our sea turtle mistakes a plastic bag as a jellyfish. "... this impacts marine organisms... All known species of sea turtles, and over 50% of sea mammals and birds... have been recorded ingesting or becoming entangled in plastic... Sea turtles often mistake plastic bags as jellyfish... Albatross mistake colourful pieces of floating plastic as fish..."

Albatross spots what he thinks is fish and eats small plastic fragments.



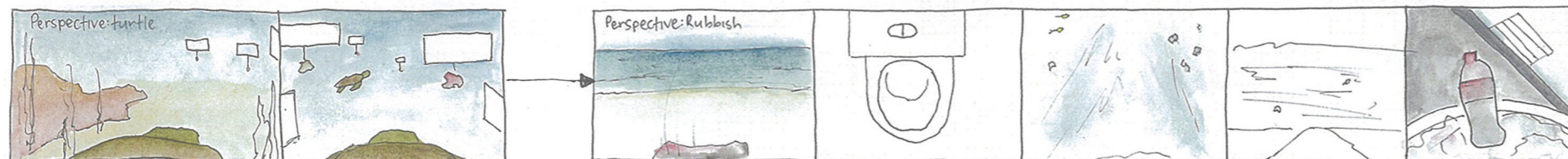
Our Albatross lands back at her nest where her chick is waiting for her. "Albatross then feed plastic to their chicks... this leads to... 90% of sea birds are affected by plastic ingestion... Sea birds have the worst records of plastic ingestion in comparison to their body weight..."

Our turtle comes to surface at a beach - he is struggling to breathe due to a plastic bag stuck in its throat. Further up the beach is a dead turtle that is entangled in plastic. "... but ingestion is not the only impact of plastic war on marine species... entanglement..."



We are now a Hector's Dolphin swimming in a pod, hunting for fish. We get entangled in a fishing net... "The net and entanglement lead to harm, and death..."

Then we are a seal. We are surrounded by other seals. We see in the distance an injured seal and move closer to see a plastic bag tightly wrapped around its neck..."



We are back in a coral reef as a turtle. Labels start popping about pieces of plastic indicating: what the plastic item is or was, who disposed/reused it, and the date/time. "... the lifecycle of plastic..."

We are now a plastic bottle blowing across a beach into the ocean. We then are a cotton bud being flushed down a toilet. We then re appear in the ocean. We then become a plastic bag being tossed into a river. Next we are a plastic bottle that is blown out of a rubbish bin, that is blown into a street drain. "... how is plastic waste entering the ocean?... land-sewage-mismanaged waste..."

Fig. 19. Multiple perspectives developed storyboard (Narrative One).

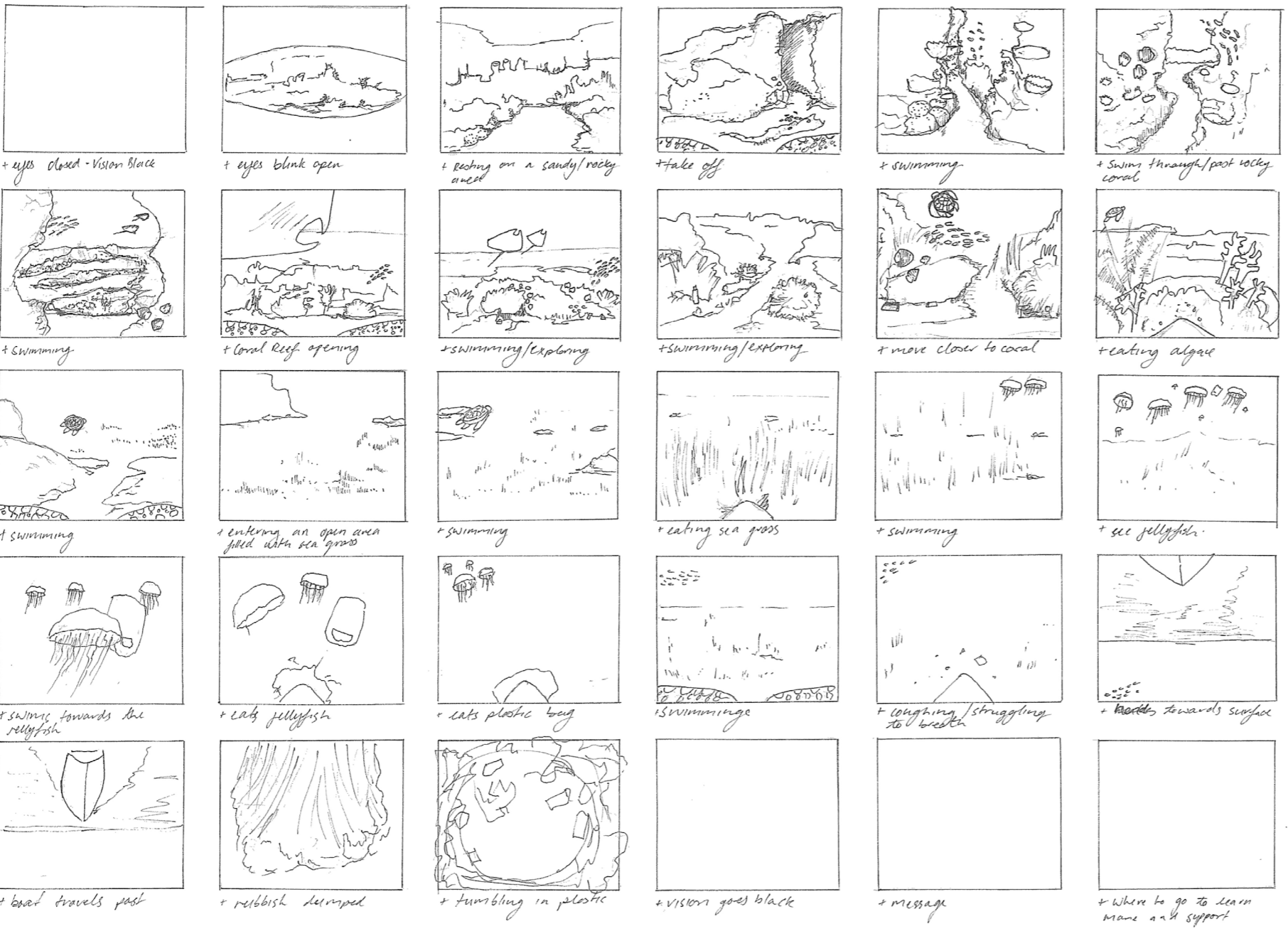


Fig. 20. Turtle and the plastic bag storyboard (Narrative Two).

Turtle And The Plastic Bag Narrative

After developing these narratives, I found the narrative that followed the perspective of a turtle to be the most persuasive and decided to continue refining and prototyping this storyline. I researched deeper into sea turtles. I realised the large impact humans have on their population. From illegal trade of eggs, baby turtles and turtle shells, bycatch, oil spills, human obstruction on habitats and ingestion and entanglement of plastic waste. The turtle became a symbol for the impacts of plastic waste has on marine species and environments for my project.

From my research, I discovered that turtles often mistake plastic for food; for example, the leatherback sea turtle often mistakes plastic bags for jellyfish. This inspired the narrative shown in Figure 20. The story begins with the turtle opening its eyes, to present to the participant a bright and colourful coral reef. They swim through this coral reef, eventually swimming between two large rocks, inspired by my dive experience. On the other side of the rocks is a large clearing filled with more coral and seagrass. Here is where we see other sea turtles and jellyfish. We eat a jellyfish, and then a plastic bag. This leads to our turtle to begin to struggle.

To conclude the experience, a boat swims over top of us, dumping a 'truckload of plastic'. This event was inspired by *Tree*. The event is designed to shock the participant before receiving statistics on plastic waste in marine environments, delivered through white text on a black background.

Plastic And The Sea Turtles Narrative

I continued developing my turtle narrative to the three-act structure and create a prototype that I then user-tested. Similar to the turtle and plastic bag narrative, the experience starts with a fade, that simulates the turtle's eyes opening, again revealing a coral reef. The participant cannot see themselves, but they can see their shadow, which reveals to them that they are a turtle, shown in Figures 21 and 22. The first act is essential as it allows the participant to adjust to the digital environment; this is important, especially for those who have not spent much time in VR. The participants in the first act will also learn the controls of the experience. This narrative has no voice-overs, so subtle hints that the participant discovers helps the participant understand what is happening. The participant is encouraged to explore and discover the digital coral reef, interacting with

other characters. The participant can move freely through space. My goal is to create magical moments the participant can discover, for example, finding another turtle and following them.

As the participant moves through the digital environment, it will become more apparent the reason for the experience, hints of plastic that glistens in the water catching the attention of the participant. The deeper the participant explores, the more frequent the plastic appears; this is where the second act, the confrontation, of the experience begins. In this act, the participant will encounter other sea turtles that have ingested or entangled by plastic waste and large quantities of plastic. The second act leads to the third and final act. As stated previously, this event is designed to shock the participant. After seeing the harmed turtles, text will appear in the space delivering statistics and information on plastic pollution in marine environments.

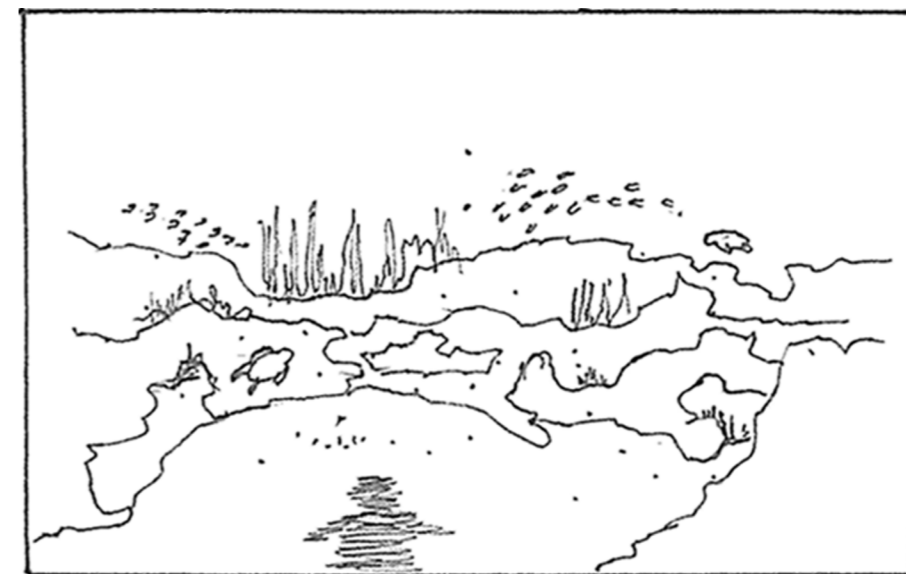


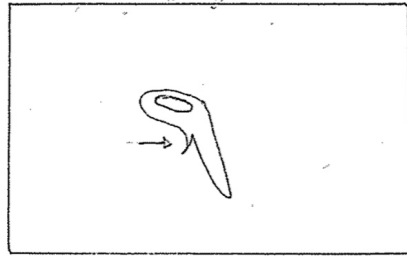
Fig. 21. Opening scene from *plastic and the sea turtles* storyboard.



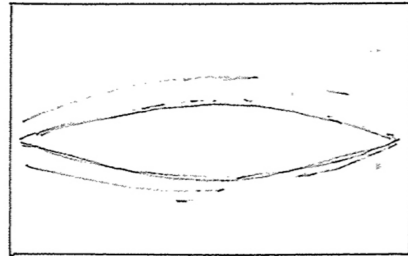
Fig. 22. The opening scene from prototype (version one).

Act 1

Background is blue which fades into black along with the anchor

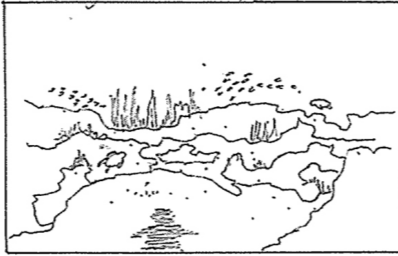


1 "To move forward, look in the direction you want to move and pull the trigger"

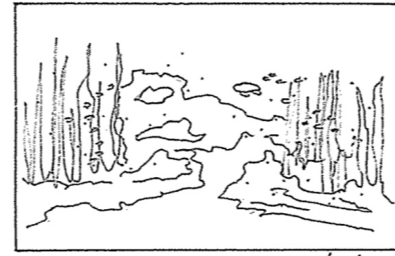


2 Our character (turtle) eyes blink open...

Our shadow works as a clue to who we are in the experience, along with our movement.

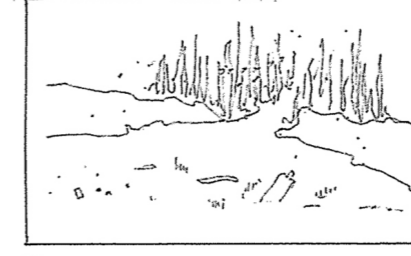


3 ... revealing a bright colourful coral reef, filled with colourful fish.

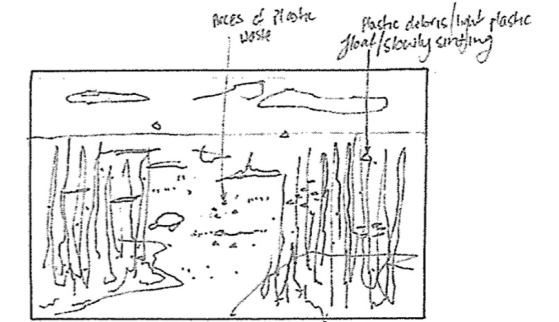


4 The beginning is an adjustment period while the user gets used to the controls and being in VR. Also introducing the environment they are in.

Plastic objects glister to draw the users attention towards it

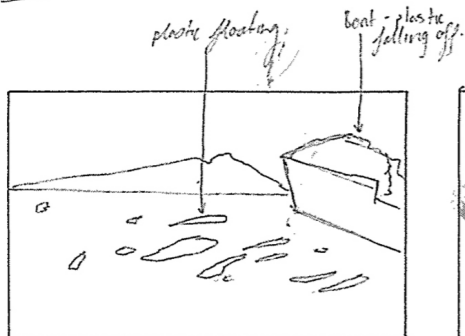


5 slowly hints of plastic pollution appears.



6 As the user moves further through the environment plastic waste appears more and more.

Act 2

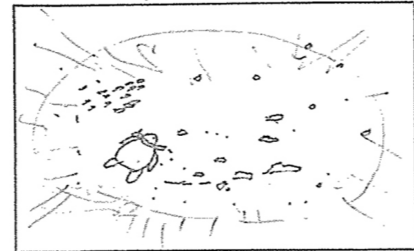


7 the user can move towards the surface and put their head out of the water, they will see a boat and plastic floating on the surface of the water



8 When our character comes in contact with plastic, our vision blurs and our character makes sounds of struggle.

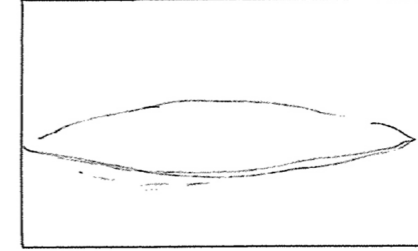
After contact with the users first piece of plastic a timer starts. our vision will slowly blur. Once reached a certain point our characters eyes will close. When the user touch more plastic their vision will blur more.



9 There will be another turtle that is struggling (choking on or being strangled by a plastic bag or netting).



10 When the user moves closer to the character they will see better the cause of the turtles struggles.



11 Once the character's vision blurs to a certain point, our characters eyes will close...

Act 3

Black with white text

8.8 Million Tons of Plastic waste enters the ocean every year...

12 followed by quotes/ information...

"That's the same as a garbage truck dumping a full load of trash into the ocean every minute..."
- World Wildlife Fund

13

As a result increasing numbers of marine species have been found entangled or died as a result of ingesting plastic.

14

Reduce, Refuse, Recycle

15

Protect our Ocean and its species

16 The End.

Fig. 23. Plastic and the sea turtles narrative storyboard (Narrative Three).

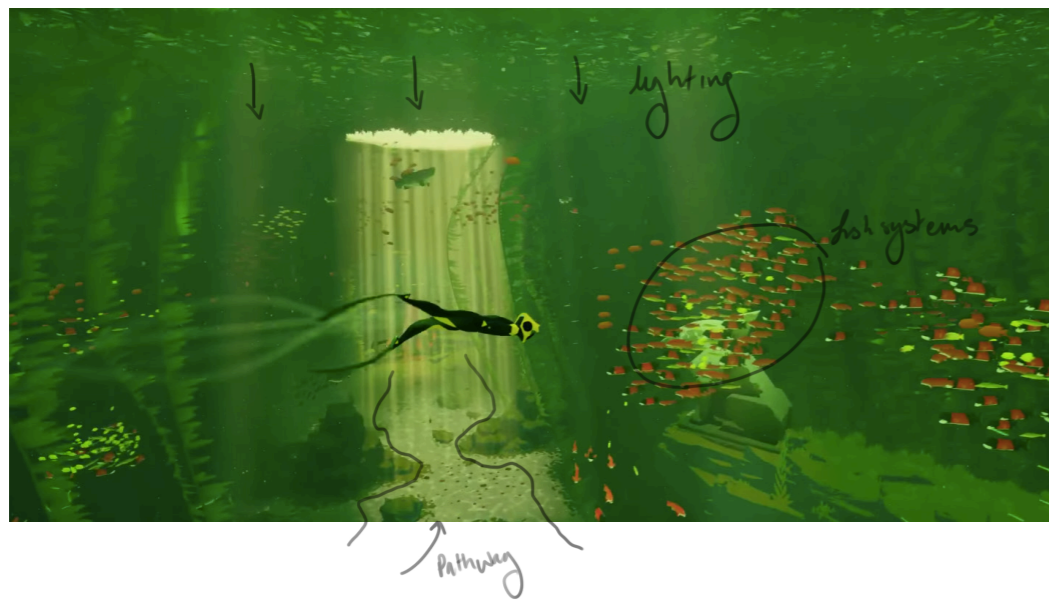


Fig. 24. A still from the video game *Abzu*.

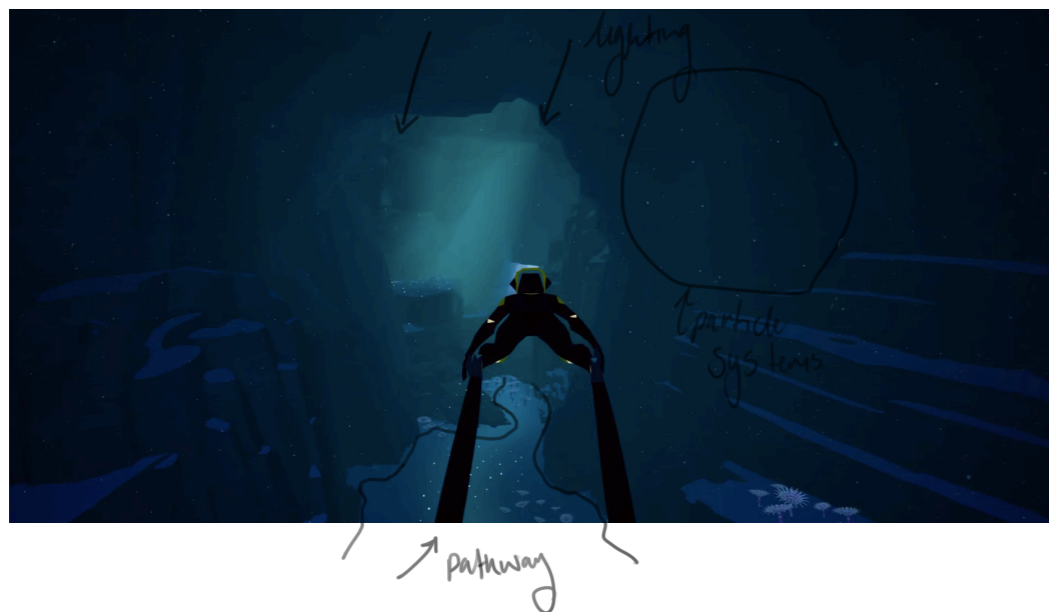


Fig. 25. A still from the video game *Abzu*.

Making

Environment Design

When creating my experience, I took inspiration from the game *Abzu* created by Giant Squid Studio. The adventure style game was inspired by scuba diving and the beauty of the ocean and underwater environments. The focus of the game was the aesthetics and to capture the essence of dreaming. The game was made in Unreal Engine 4 and Maya, which are the same software programs I have been using. The movement in *Abzu* is similar to my experience as the character can move in any direction freely. The game uses pathways and lighting to pull the player through the digital environment. The game has large open areas where the player is encouraged to explore, combined with cave-like regions that work as transitional spaces (shown in Figure 25). I took inspiration from this along with my dive experience, to guide my participant through the environment. This allowed me to strategically place objects in the participants sightlines to make sure they saw what the experience intended them to, for example, the harmed turtles.

Mapping

After storyboarding my narrative, I started designing my space within 3D software. Figure 26 shows my first plan of the turtle and the plastic bag narrative. At this point of my design, the participant had no control in the story; instead, it was a 360 video. Therefore there was a start and endpoint in the experience. I developed the experience to be interactive and allow the participant the freedom to explore and discover. Allowing the participant to control where they go makes the experience more engaging. I laid out the space in the shape of a rectangle, the rocks working as a barrier so the participant would naturally head down the map where plastic will accumulate more and more. The participant starts close to the beach and ends deeper by the boat. After testing this version on a couple of people, I found people often turned around and head to the beach and off the map.

I changed the shape, so it was tighter at the beginning and got wider as the participant went deeper. This was to encourage the participant to move in that direction. Through prototyping and testing, I discovered that because the participant had the freedom to move through the digital environment, and the



Fig. 26. Turtle and the plastic bag narrative journey map.

end section of the experience was so wide it was hard to guide the participant to the boat. My solution for this was to move the rock wall closer together in the middle of the experience to direct the participant to the boat (shown in Figure 28). I also place the affected marine species at both ends of the 'tunnel' so that the participant could not miss them, rather than them being spread throughout the map, and the participant potentially missing them (Figure 27). This also allowed me to condense the plastic into one area of the experience.

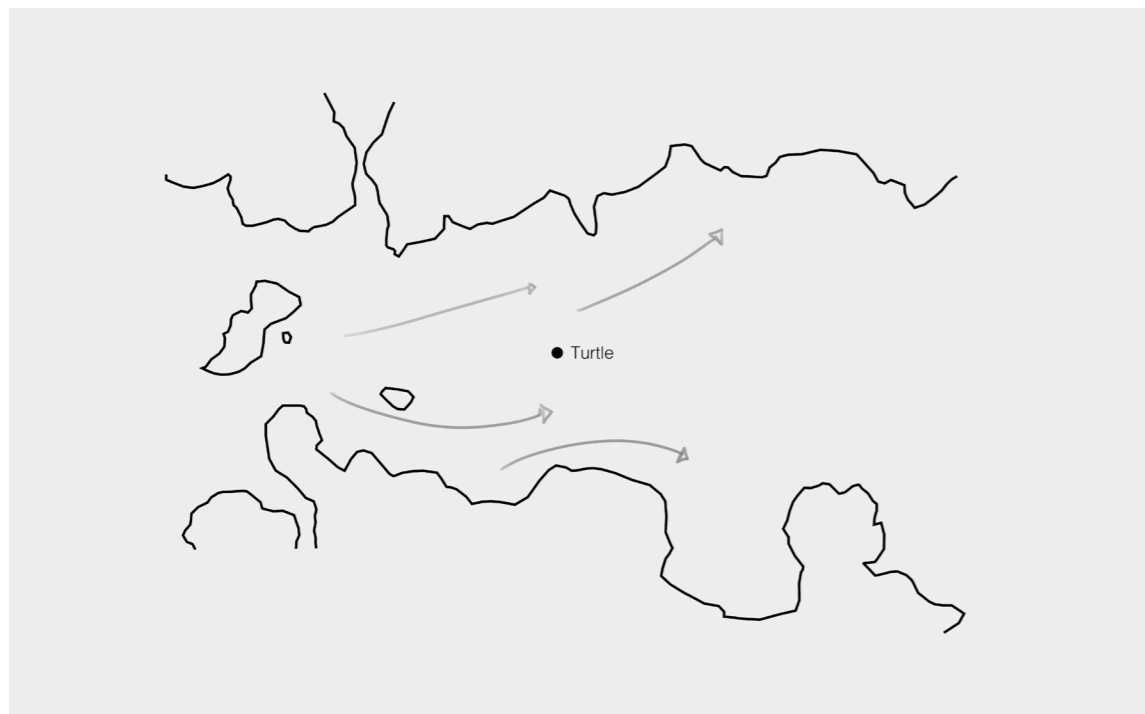


Fig. 27. Development perspective and map.

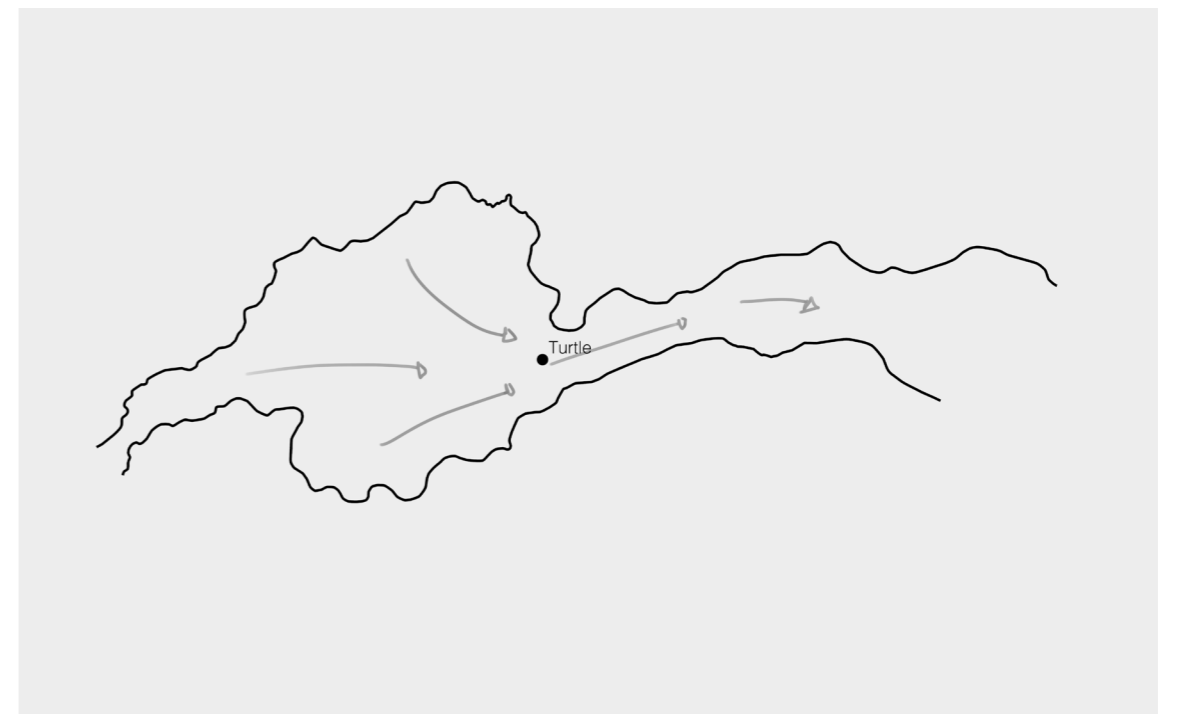
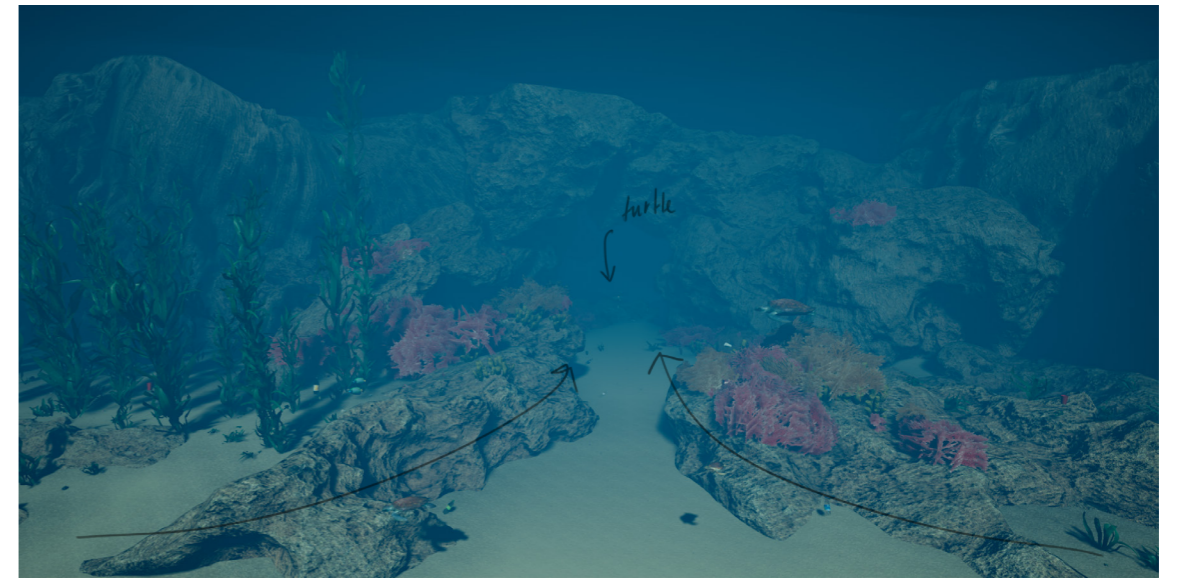


Fig. 28. Prototype (version one) perspective and map.

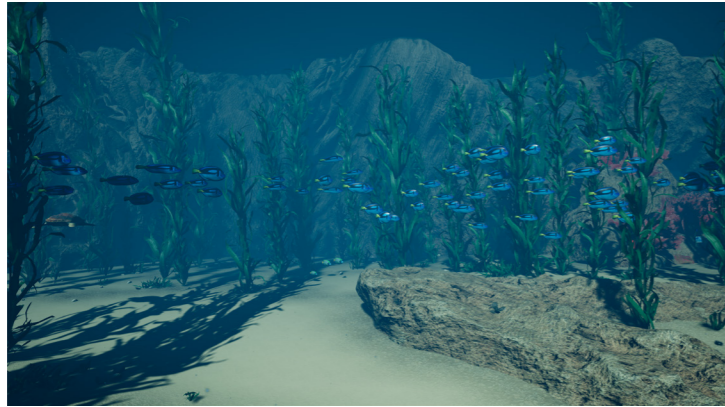


Fig. 29. Fish particle system example.

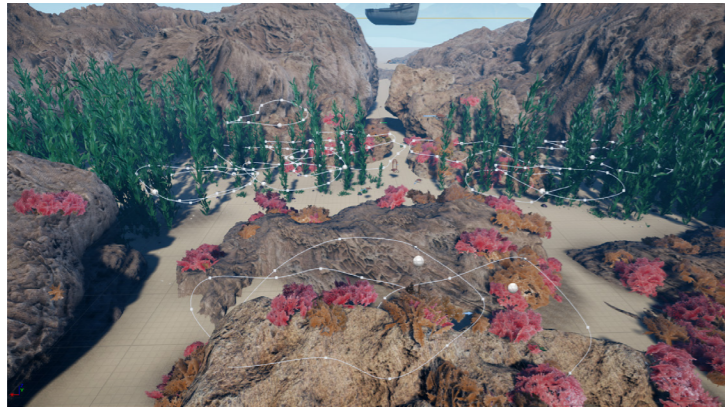


Fig. 30. Fish on tracks example.

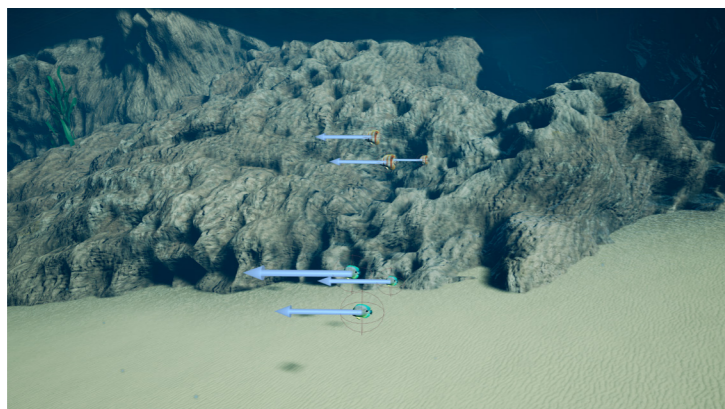


Fig. 31. Fish characters example.

Marine Life

Another crucial part of my experience was making the space feel vibrant and lively, to reflect a coral reef. I again took inspiration from the way *Abzu* designed their marine wildlife. I tried different strategies for this, starting with a having fish particle systems. This strategy meant the fish appeared and then disappeared, breaking the immersive feel of the experience. After this, I tried a flocking system which grouped the fish as they swam. This strategy created a natural feel, but I had several technical difficulties, so I tried having the fish on 'tracks'. This meant the fish followed a particular pathway that I had set out (shown in Figure 30). This strategy was time-consuming and felt rigid and unnatural. The final solution I went with was setting a boundary that the fish can swim freely in. Along with fish, I have other turtles swimming in the experience. Similar to the controls of the fish, the turtles swim freely at a set speed and with animations.

Functionality

The event to the experience was an essential part of the experience. The experience builds up to this moment, the plastic accumulating more and more until the moment the plastic is dumped into the marine environment. I designed this, in inspiration to my research and my primary case study *Tree*. The boat, a reference to human fault, delivers the plastic into the ocean. For my first

iteration, the slider (shown in Figure 32) is timed every minute to open and release the plastic (a reference to the garbage truck a minute of waste entering the ocean every minute). I created spawners, each of the five spawners placed on the boat spawned one piece of plastic every second. This iteration began to cause issues after five to eight minutes as the computer could not keep up with the amount of plastic it needed to render and began to freeze. My solution was to dump one load of plastic, which the participant would be present for, this was animated by a trigger box. Once the participant moved through the trigger box (a particular area in the digital space, shown in Figure 36), the sliders on the boat would move, and the trash would fall down the rocks.

The same trigger box that starts the animation for the rubbish starts the message delivered through text. The final message provides statistics to give a more in-depth understanding of the participant of what they have experienced (shown in Figure 35).



Fig. 32. Plastic spawners delivering plastic every minute into the water below.

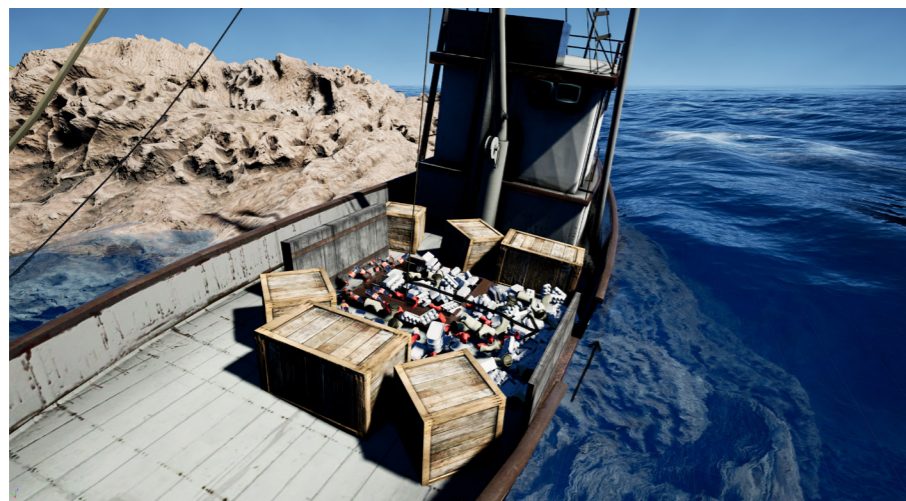


Fig. 33. Prototype (version one) plastic delivery from the boat into the final scene.



Fig. 34. Statistic video frame.



Fig. 35. Statistic video in experience.

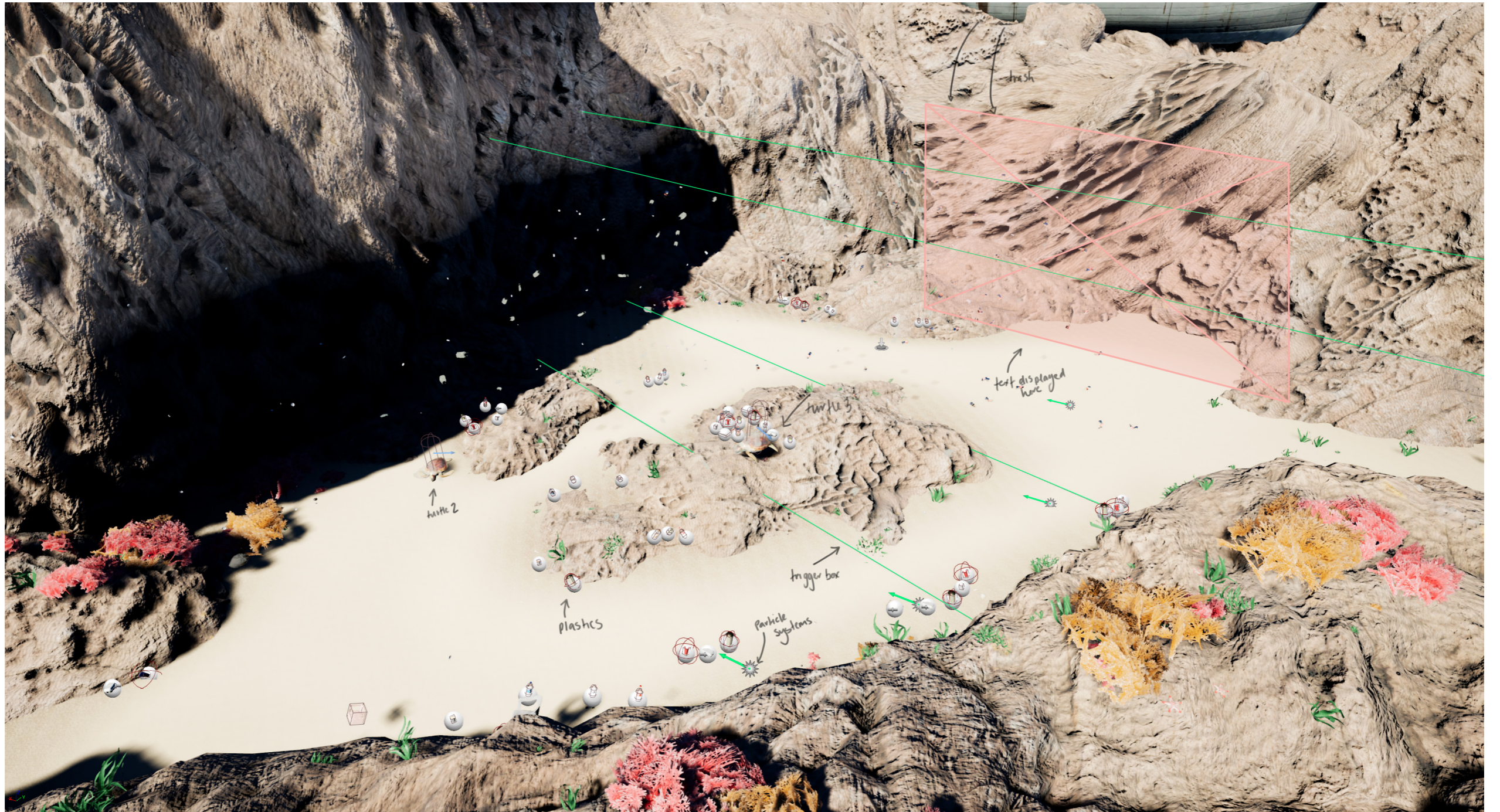


Fig. 36. Final scene for experience prototype (version one) functionality diagram.

Models

Textures

Exported

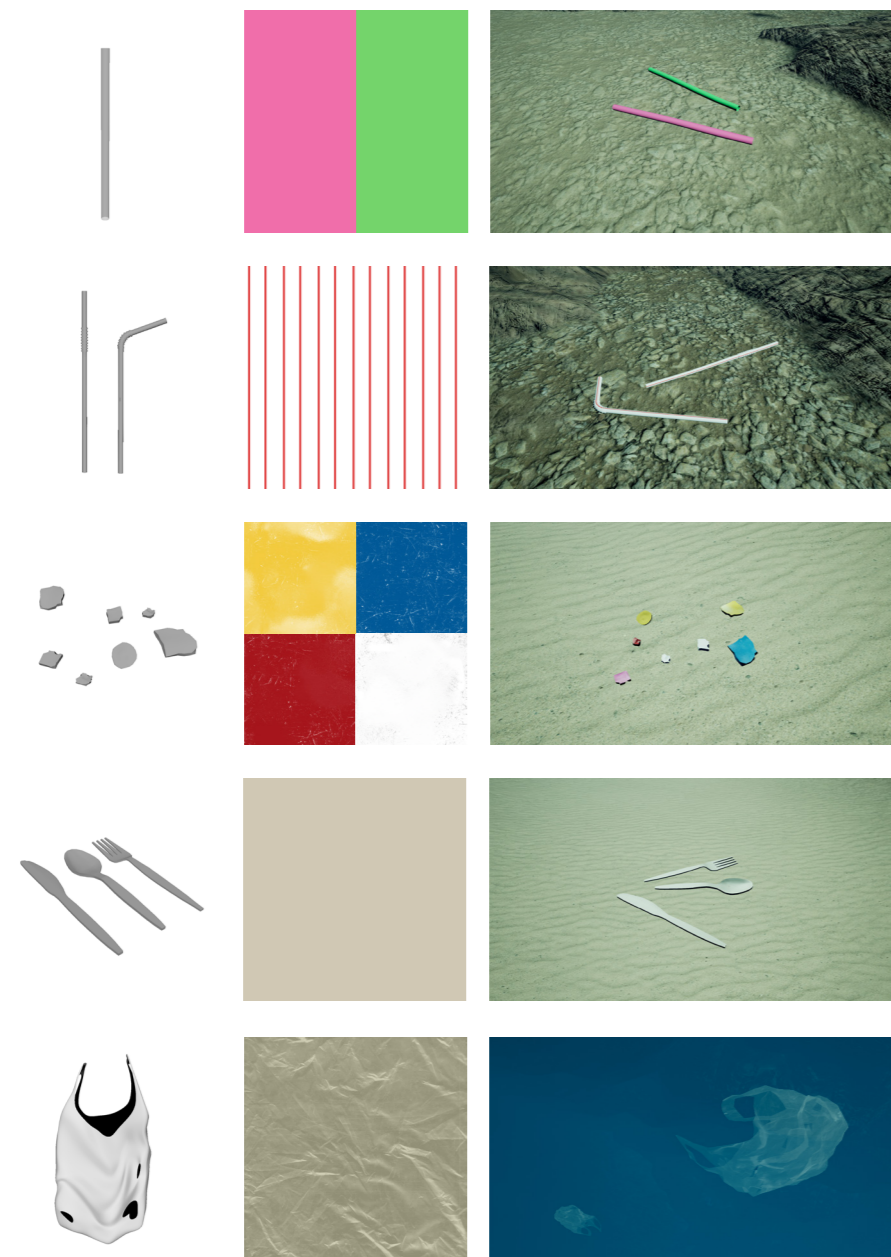


Fig. 37. Plastic objects model in Maya, textures created in photoshop and exported into experience.

Modelling

A part of my design process was modelling assets and then exporting them to Unreal Engine 4. I modelled these objects in Maya, created textures and materials before exporting them to my experience. The objects I modelled were essential to the narrative, for example, plastic straws and bags. Also crucial to the narrative was the plastic bags that are wrapped around the turtles in the space. I made two different examples of these, one with where the bag handle is wrapped around the turtle's neck and another with the bag going over its head.

Particle Systems

From the models I made and downloaded, I created particle systems to produce floating plastic. This fills the space more with plastic, which the participant then has to swim through plastic, enhancing the atmosphere of the digital environment. I also utilised particles systems not only for plastic but also as marine dust.

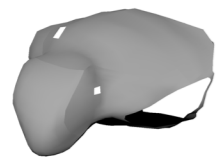
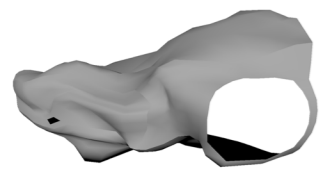


Fig. 38. Turtles in plastic bags modelled in Maya and exported into VR experience.



Fig. 39. Plastic particle systems.



Fig. 40. Ocean dust particle system.



Fig. 41. Plastic bag and debris in VR experience.



Fig. 42. Me scuba diving in Wellington's Taputeranga Marine Reserve, New Zealand.

Becoming a Scuba Diver

Due to my design output set in a marine environment, it was vital for me to have a deeper understanding of oceanic environments. Therefore going scuba diving allowed me to experience being and breathing underwater. I signed up to become an open water scuba diver at Dive Wellington. The course included online classes, pool training and open water training (see Figure 45 for dive locations).

The open water dives ran over a weekend, both days we did two dives. On the first day, we went to Kau Bay out in the harbour (Figure 43). I did my scuba diving course in winter 2019, so I had a thick wetsuit, gloves, vest and a hood to keep me warm. I was shocked at how little I could see. The ocean was a cloudy olive colour, filled with tiny organic particles. We snorkelled out from the harbour before descending. The bottom of the ocean out in Kau Bay was covered in starfish and sea urchins. The ocean floor was sandy, with little pebbles and shells. We swam along the edge of a kelp forest, which with a short viewing distance created dark shadows, giving the underwater atmosphere an airy, spooky feeling.

The Sunday dives we were out in Wellington's Taputeranga Marine Reserve off the coast of Island Bay. The Marine Reserve had a lot more aquatic life than in the harbour. It was filled with large rocks, seaweed. The ocean floor was a mixture of sandy and rocky surfaces. The current in the marine reserve was powerful in areas. And I saw one piece of plastic, a black takeaway coffee cup lid. For my final dive, we had no drills, so I was able to explore more of the marine reserve. We swam between large rocks that created these tight passageways filled with crayfish, aquatic plants and fish. These spaces were dark as a small amount of light could squeeze through the gap at the top of the rocks. The marine reserve also had large open areas, where the sand had wave-like ripples created by the currents.

Even though my marine environment is based on a more tropical climate, I learnt a lot on marine environment composition from my experience, which I was able to translate into my digital space. I also learnt a lot about how it sounds in an underwater marine environment. The marine dust was dense and filled the space, reducing viewing distance. I added particle systems to my experience because of this. Going scuba diving enabled me to have a deeper understanding of underwater environments, allowing me to create a more realistic digital representation.



Fig. 43. Dive location: Kau Bay, Wellington, New Zealand.

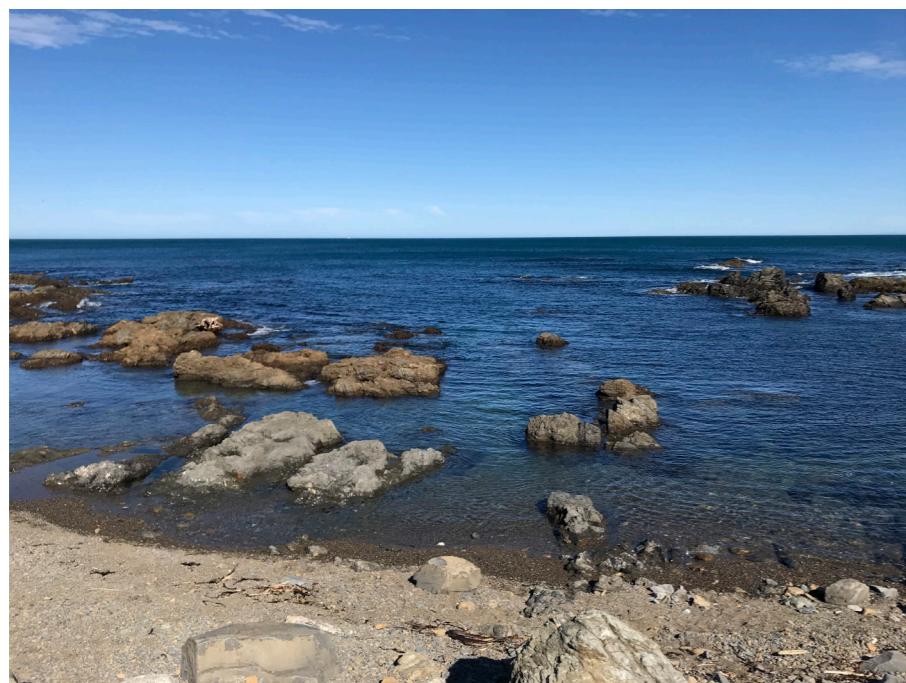


Fig. 44. Dive location: Taputeranga Marine Reserve, Wellington, New Zealand.

Dive Log

Dive Location One: Wellington Regional Aquatic Centre

Try Dive

Date: 06/07/2019
Time: 10am-11am
Depth: 2 meters

Pool Dive 1

Date: 17/08/2019
Time: 8am-12pm
Depth: 2 meters

Pool Dive 2

Date: 18/08/2019
Time: 8:30am-12pm
Depth: 5 meters

Dive Location Two: Kau Bay, Wellington

Ocean Dive 1

Date: 24/08/2019
Time: 10:17am - 10:42am (25 minutes)
Depth: 5.9 meters
Temperature: 11 degrees
Visibility: 4 meters
Environment: seaweed
Ocean floor: sandy, pebbles, shells
Species Seen: jellyfish, starfish, sea urchins, fish, crabs.

Ocean Dive 2

Date: 24/08/2019
Time: 11:56am - 12:28pm (24 minutes)
Depth: 8.8 meters
Temperature: 11 degrees
Visibility: 4 meters
Environment: seaweed
Ocean floor: sandy, pebbles, shells
Species seen: seahorse, fish, starfish, sea urchins.

Dive Location Three: Wellington Marine Reserve

Ocean Dive 3

Date: 25/08/2019
Time: 9:26am - 9:51am (25 minutes)
Depth: 9.1 meters
Temperature: 13 degrees
Visibility: 5 meters
Environment: large rocks, seaweed,
Ocean floor: sand, smooth rocks,
Species seen: fish, crayfish.

Ocean Dive 4

Date: 25/08/2019
Time: 11:12am - 11:39 (27 minutes)
Depth: 9.3 meters
Temperature: 13 degrees
Visibility: 5 meters
Environment: large rocks, seaweed,
Ocean floor: sand, smooth rocks,
Species seen: fish, crayfish.

Fig. 45. Dive log.



Fig. 46-57. Stills from my scuba diving experience in Wellington's Marine Reserve, New Zealand.

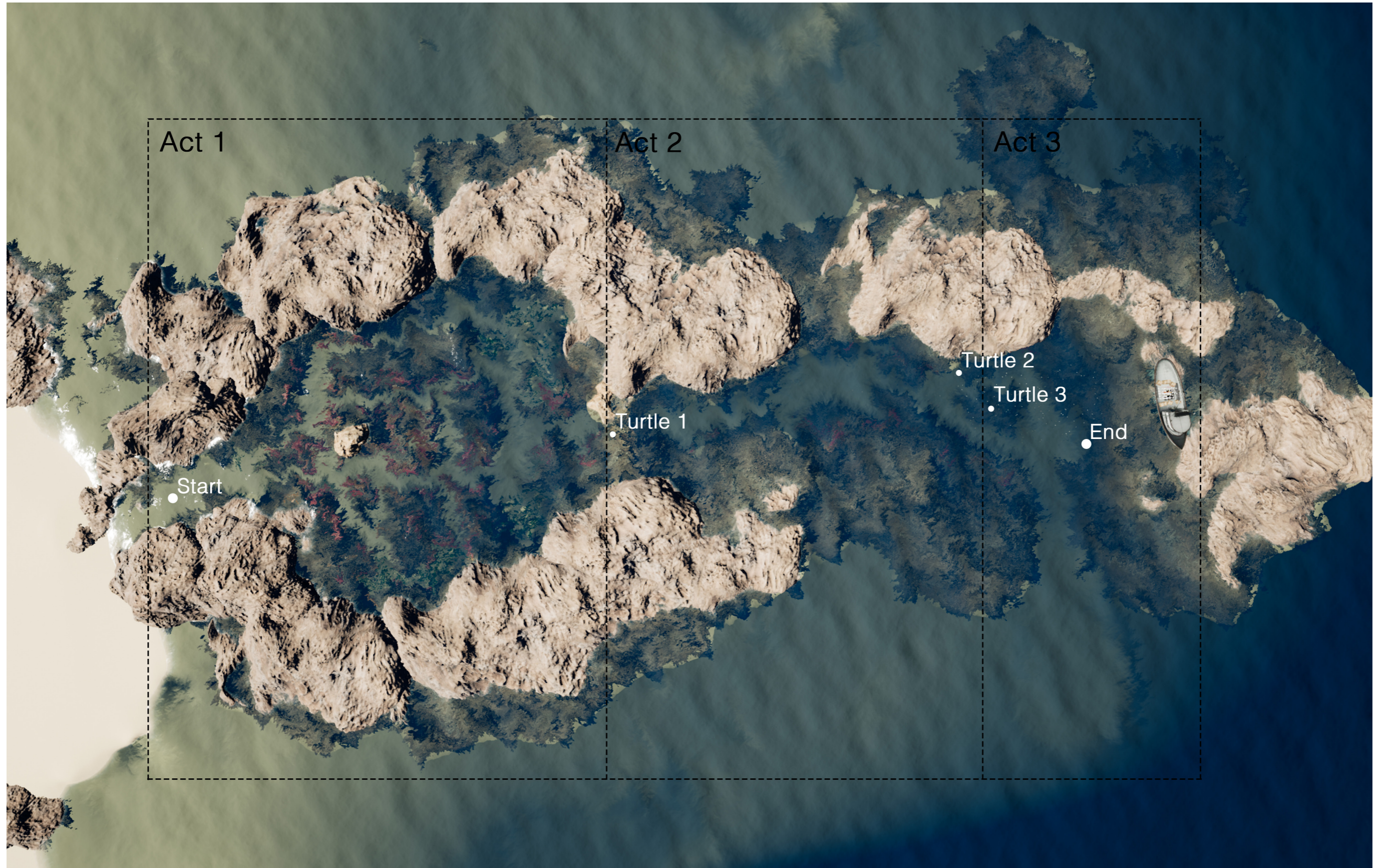


Fig. 58. Prototype (version one) map of environment, turtle locations and three-act structure regions.



Fig. 59. Injured turtle one (straw in nostril).



Fig. 60. Injured turtle two (plastic bag handle around the neck).



Fig. 61. Injured turtle three (plastic bag around the neck).

Prototype

Figure 58 shows the map of the prototype I designed in preparation to user test. I have indicated on the map where the different act occurs, which is in reference to my final storyboard (Figure 23). This map indicates pathways and boundaries I have set up. The first section (act 1), as I have discussed, is designed for the participant to explore and discover the digital marine environment. The second and third act, the environment is substantially smaller; this is so I could have more control over where my participant went and what they saw.

The numbers on the map indicate the locations of the injured turtles in the virtual environment. Figure 59 shows the first turtle the participant will encounter. The turtle has a straw stuck

in its nostril, which is symbolic of the turtle I discussed in the introduction. This encounter is a turning point in the narrative; it is where the participant realises the context of the project, and sets the tone for the rest of the experience.

The turtles with the plastic bags wrapped around their neck and head are influenced by the images I have found of marine species entangled in plastic bags. These turtles are designed to spark empathy in the participants. In the third act, after seeing the third turtle, the statistics will appear, and trash will begin to fall down the side of the rocks behind the text. This is to visualise the amount of waste entering the ocean every minute and to back up the statistics displayed to the participant. After this, the experience fades to black.



Fig. 62-67. Prototype (version one) perspective images.



Fig. 68. Prototype (version one) perspective image.

Section 4: User Testing

Recruitment

User testing in my research is the process of testing my virtual reality experience on participants to receive a more in-depth understanding of how they perceive the experience. And whether or not the experience elicits empathy.

My user testing included a recruitment survey that asked questions relating to the project, along with an option to leave their contact details if interested in participating in the user testing held at Massey University Wellington. After participants finished the experience, they filled out another survey. From the feedback that was given, I was able to respond and develop my experience.

The eight questions in the recruitment survey asked questions relating to age, level of virtual reality experience, and environmental awareness. I had 112 responses to the survey. The largest age bracket was 16 to 24-year-olds at 55.4% (62 participants). 39.3% of people who took the survey had never used VR before and 12.5% having three or more VR experiences. Interestingly when asked 'Are you aware of plastic pollution in marine environments?', 99.1% of people said

yes with only one person out of the 112 responses said no. But when asked 'do you avoid plastic packaging when making purchases?' the most popular answer was sometimes with 62.5% (72 participants), showing that when making purchases the type of packaging the product comes in doesn't necessarily impact whether they buy the product or not. When asked; 'are you concerned about the amount of waste you produce?', 76.8% (86 participants) said yes, with the same result for 'do you recycle?'

User Testing

I had a total of 21 participants test my experience and fill out the second survey. From the survey and verbal feedback on the day, I found repeated issues or areas of the experience that were not clear to the participants. One of these was how I deliver the statistics.

In the second survey after the experience, when asked for further comments on the experience, some mentioned they had trouble reading the message (shown in Figure 71), due to being blurry, large, and fast. This led to the participant not being able to read the text. In some cases,

*Consent forms, information sheets, survey questions and results from user testings are located in the Appendices.



Fig. 69. Photo from user testing.



Fig. 70. Photo from user testing.

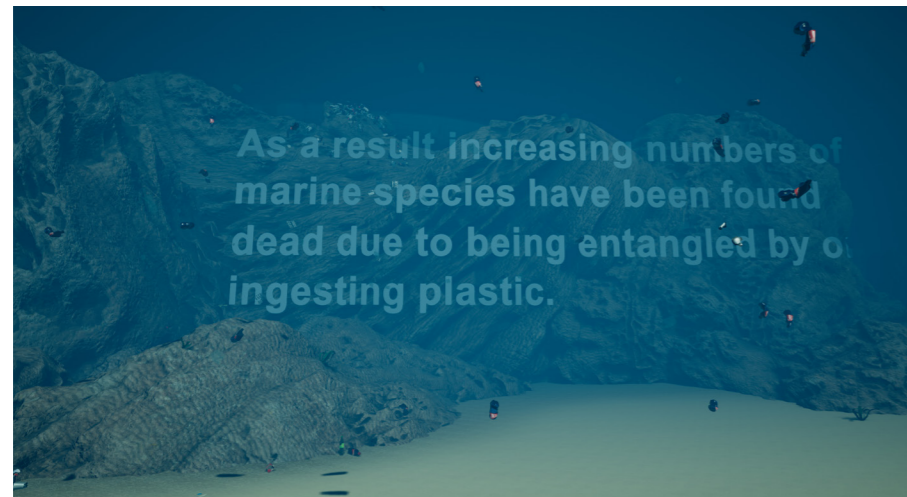


Fig. 71. Delivery of statistics through written text in the digital environment.



Fig. 72. Plastic chair in VR experience.

the participants missed the statistics entirely due to other distractions in the space and not expecting there to be text. For these reasons, I found the use of text to deliver information in the virtual environment to be unsuccessful. As a crucial part of the experience, I looked at how I would improve this in my next prototype.

Another issues discussed was some expected to be more shocked, or they felt it did not represent how bad the situation is;

“ I didn’t get the emotional response I expected. I wanted to feel more angry about it... ”

The user testing journey map (Figure 73) shows in the wider areas of the map there are more opportunities for people to explore, this lead to some participants getting lost or feel like they were going in circles. Eliminating the possibility of participants exploring too far away from the main pathway will improve on this. It was also mentioned there was a lack of guidance at the beginning, for example, a participant stated; “I think some kind of guides, or aim at the beginning to know [what] you are searching for”. Applying guidance and improving navigation will improve the experience immensely and will eliminate participants from becoming frustrated.

There were positive reactions to the overall experience; “It was well thought out and prompted further interest into

this problem”. Participants found the movement of the character and the flow of the space to feel natural; “The movement was quite fluid and I managed to go where I wanted to”. All participants knew they were a turtle most realising straight away, and had positive reactions to seeing other turtles in the space, often chasing after them, creating a playful element to the experience before moving into act two of the narrative.

Participants had a surprised reaction to seeing the plastic chair (shown in Figure 72), a couple of participants interacted with it and other objects, they were surprised and excited about this. But most people weren’t aware they could move/ interact with objects. I have indicated on the user testing journey map where the chair was located in the experience.

It shows that people were drawn to the large object and swam towards it. It also shows where the turtles are located, indicating that every participant swam past the first turtle. People missed some of the hurt turtles or didn’t pay much attention to them; some, however, did stop for a second to look. A lot was going on in the space, and people were quick to move on. My role is to design for this, narrowing pathways in areas to direct them to where I want them to go.

When asked in the survey ‘what happened in the experience?’, the standard response was “I made my way through the ocean, which began to get filled with more and more rubbish”, this shows people understood the underlying narrative of the experience. A more detailed response was;



Fig. 73. User testing journey map.

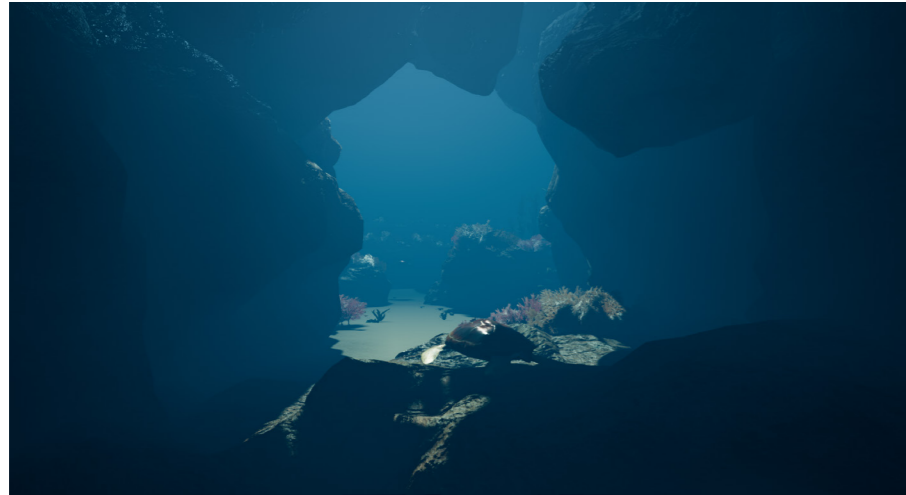


Fig. 74. Transitional space between the clean coral reef and the dense plastic area referred to as Cave.

“ I swam around going deeper into the ocean, as I went deeper there were more and more bits of trash floating and on the ocean floor along with dead or hurt turtles or ocean life. ”

One of my participants mentioned they noticed the transition between the two spaces; the clean coral reef environment compared to the area with dense plastic waste (act one and two). The shift is a cave-like feature where the first turtle is located (shown in Figure 74).

In response ‘did you feel in control of the experience and what happened?’ and the follow-up question ‘why?’, an

answer was; “I felt in control of my actions as the turtle, however I was quite lost in the reef & potentially could have just swim around in circles if I wasn’t promoted”. Again this comment refers to the lack of guidance given at the beginning of the experience. Another response was; “although I could go where I wanted there was a specific path that it wanted me to take where scripted events that were outside of my control happened”. Some wrote that they felt in control as they were in control of the turtle. A couple of other responses referred to the plastic and turtles; “I couldn’t stop the increase of plastic or save the sea life affected”, showing a sense of wanting to help and empathy. Another response indicating an empathetic response to the experience;

How immersed were you in the space?

21 responses

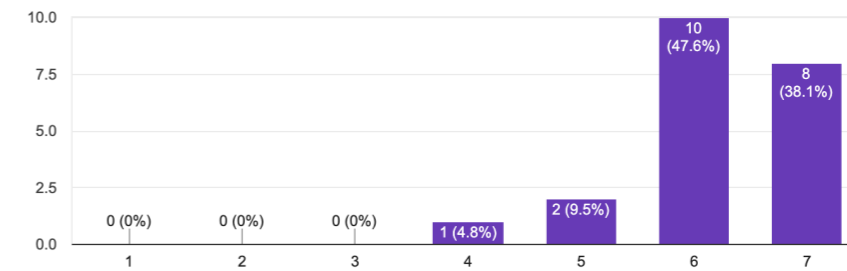


Fig. 75. User testing survey results for question: How immersed were you in the space?

What emotions did you feel from the experience?

21 responses

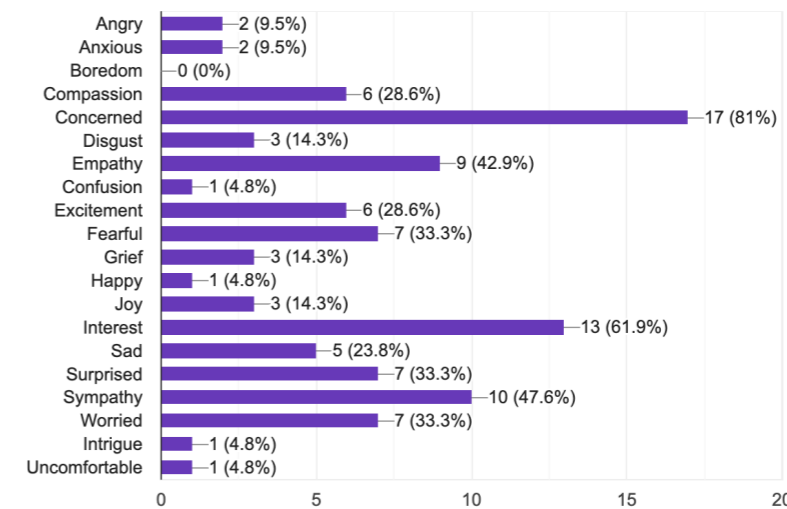


Fig. 76. User testing survey results for question: What emotions did you feel from the experience?

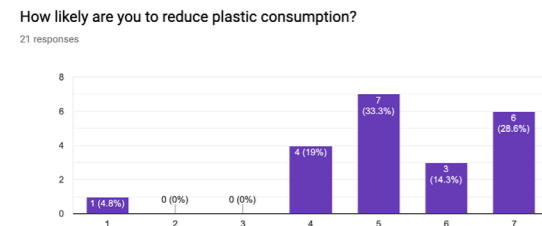


Fig. 77. User testing survey results for question: How likely are you to reduce consumption?

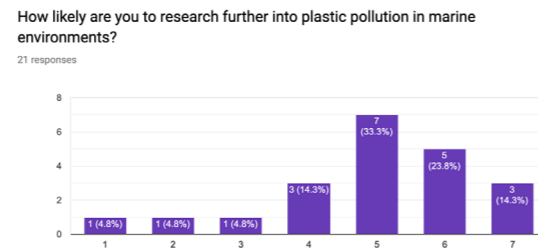


Fig. 78. User testing survey results for question: How likely are you to research further into plastic pollution in marine environments?

Do you feel motivated to act on what you saw? (for example donate to charity, participate at beach clean ups, etc)

21 responses

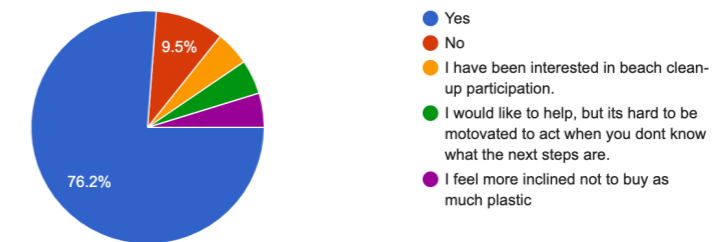


Fig. 79. User testing survey results for question: Do you feel motivated to act on what you saw?

“ I instinctively wanted to pick up the few pieces of rubbish I saw initially but as a turtle - was unable to. The more rubbish that started appearing the more I felt helpless. It made me feel uncomfortable. ”

It is clear that as humans, we instinctively want to pick up rubbish but in this simulation, as a turtle, we can not. In the case of this participant mentioned above, the experience was successful in provoking an empathetic response.

The response to the question ‘how immersed were you in the experience’; I had high results with all answers above 4 with a majority 18 out of

21 sitting at 6 or 7. Some of the participants mentioned how the audio positively affected the experience, enhancing their immersion of the space. They appreciated the ocean sounds and the sounds of the trash falling down the rocks. I took inspiration from my case study *Tree*, where the atmospheric audio enhanced the natural feeling and immersion of the experience.

The highest response to the question ‘what emotions did you feel from the experience?’ (Figure 76) was *concerned* at 81%, this shows that participants responded to seeing the turtles. *Sympathy* was at 47.6%, and *empathy* at 42.9%. The second highest response was *interest* at 61.9%. The experience, presently, elicits

high levels of concern and interest, the goal for the next prototype is to receive higher levels of sympathy and empathy.

When asked ‘what events provoked these emotions?’, typical responses were “seeing the hurt or dead turtles along with all the trash floating around” and “the dying turtles and the fact that I couldn’t do anything about it”.

One out of 21 participants responded to the question ‘how likely are you to reduce plastic consumption?’ with very unlikely. But the rest of the participants (95.2%) selected four and above. The results to ‘how likely are you to research further into plastic pollution in marine environments?’ were more varied, with the majority sitting at 5

(shown in Figure 78). In response to ‘do you feel motivated to act on what you saw?’ 76% of people (16 out of 21) said yes, with 9.5% said no (two out of 21). The other comments from the other three participants were helpful for me to respond to when developing my experience. One said;

“ I would like to help, but it’s hard to be motivated if you don’t know what the next steps are. ”

This may mean the experience needs to deliver more precise solutions to the participants. Others said they are more inclined to participate in beach clean-ups or to reduce plastic consumption.



Fig. 80. Design output
(version two) perspective.

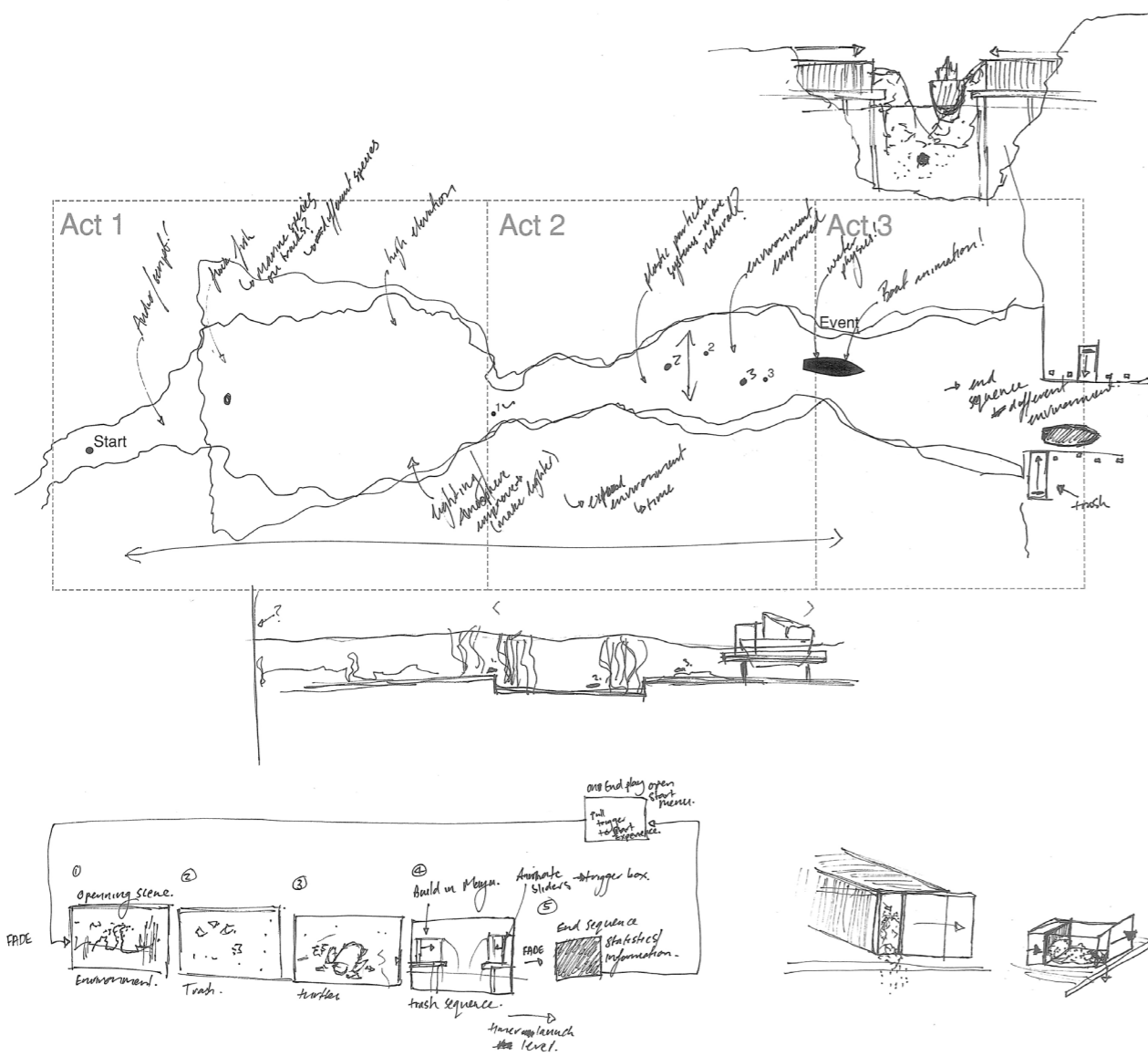


Fig. 81. Prototype (version two) plan sketches.

Design Output

In response to my user testing, I developed my first version of my VR turtle experience. Throughout this section, I will discuss the adjustments I made in response to the feedback I was given. Firstly, I developed my narrative in relation to the three-act structure. Most of my development was at the end of the experience. Instead of having the text and trash playing at the same time, the waste will drop, more dramatically from shipping containers on a dock, landing on top of the participant. The

experience will then fade to black, suggesting that after swimming through all of the plastic waste, the participant's fate was the same as the other three injured turtles. The text will then appear, delivering the final message.

I modelled the dock and the containers for the final event in Maya. I added two extra containers than previously planned as the trash from just two didn't fill the digital environment. The timing was crucial for the final event; for this, I place the trigger box directly between the containers, to trigger the event when the participant was in

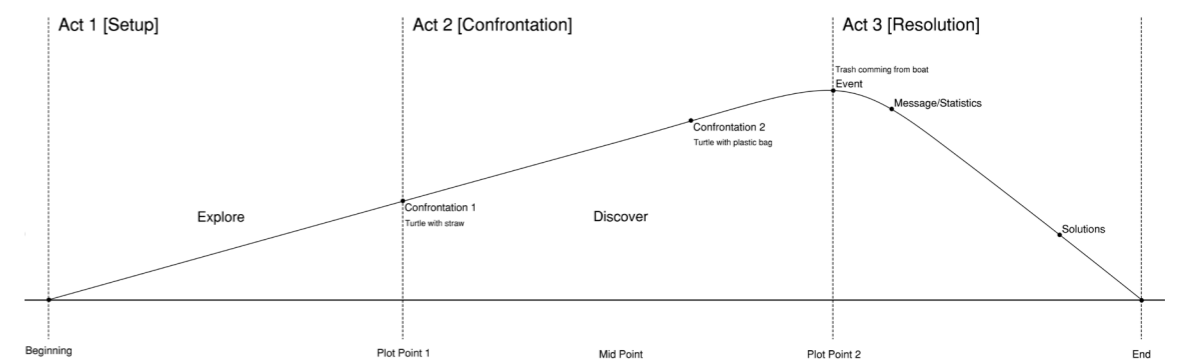


Fig. 82. Prototype (version two) three-act structure narrative plan.

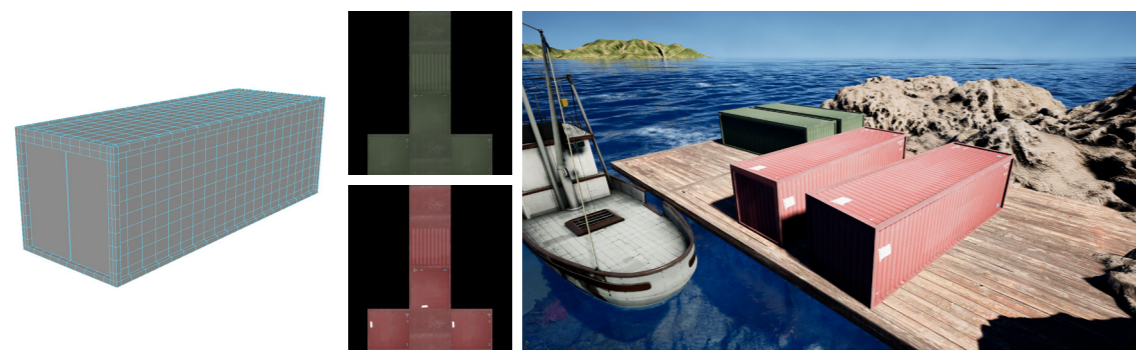


Fig. 83. Container model making.

the correct position. I programmed the doors on the containers to open, with a wall pushing the plastic out at the same time, this resulted in a rush of plastic into the ocean. Once the trash has fallen, landing on the participant, the experience fades to black, and the message is delivered through white text on a black background. I have edited the written text to make it easier to read and a more detailed explanation of the issues and results of the environmental issue along with a call to action (shown in Figures 84-89).

I also modelled another plastic item to go on a turtle; this was to create a larger variety of types of plastics causing

injury. The turtles are also more spread out and placed in better sightlines for the participant to encounter. Combined with this, I have made the plastic more dense in the final area, to spark a more significant response and build-up to the final event.

The turtle's placement can be seen on the final environment map (figure 103). I have tightened the space again in the first act area to help eliminate the chances of participants getting lost, and lengthened the second and third act areas. This is to extend the time spent in these areas and to add more for them to discover.

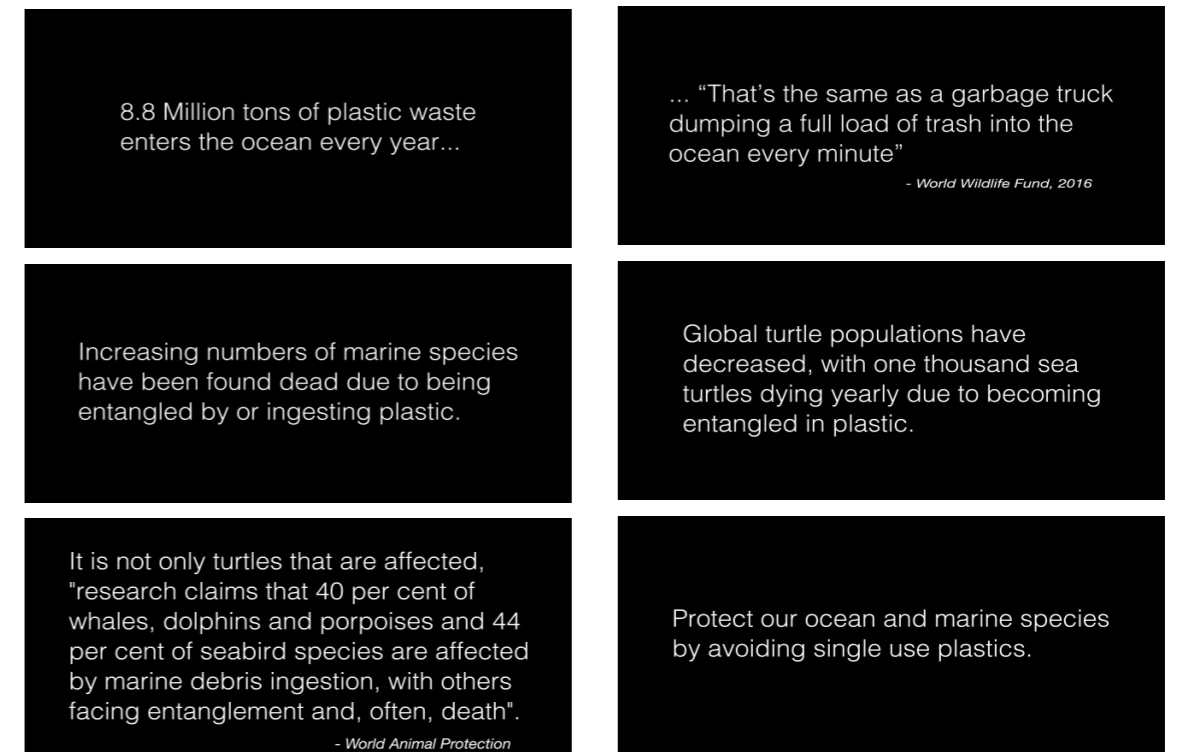


Fig. 84-89. Final message sequence.

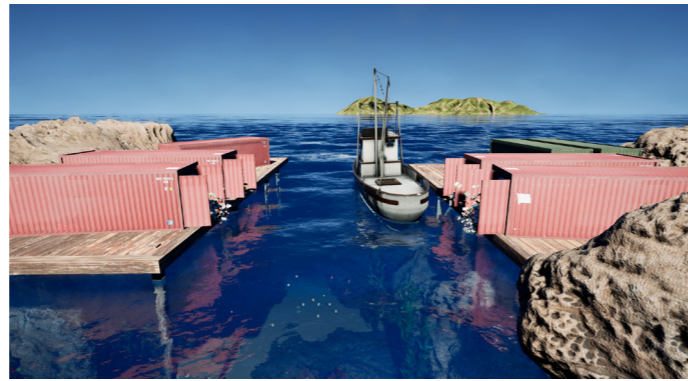


Fig. 90-97. Final event sequence.

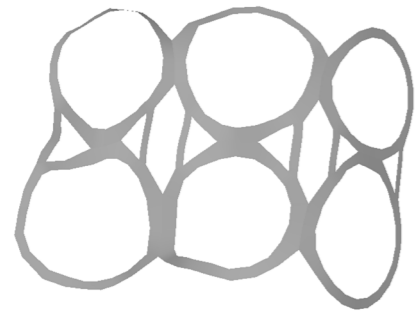


Fig. 98. Plastic six-pack can holder Model.



Fig. 99. Plastic six-pack can holder particle system.



Fig. 101. Final (version two) injured turtle placement (turtle one).



Fig. 100. Injured turtle with a plastic six-pack can holder (turtle two).



Fig. 102. Final (version two) injured turtle placement (turtle three).

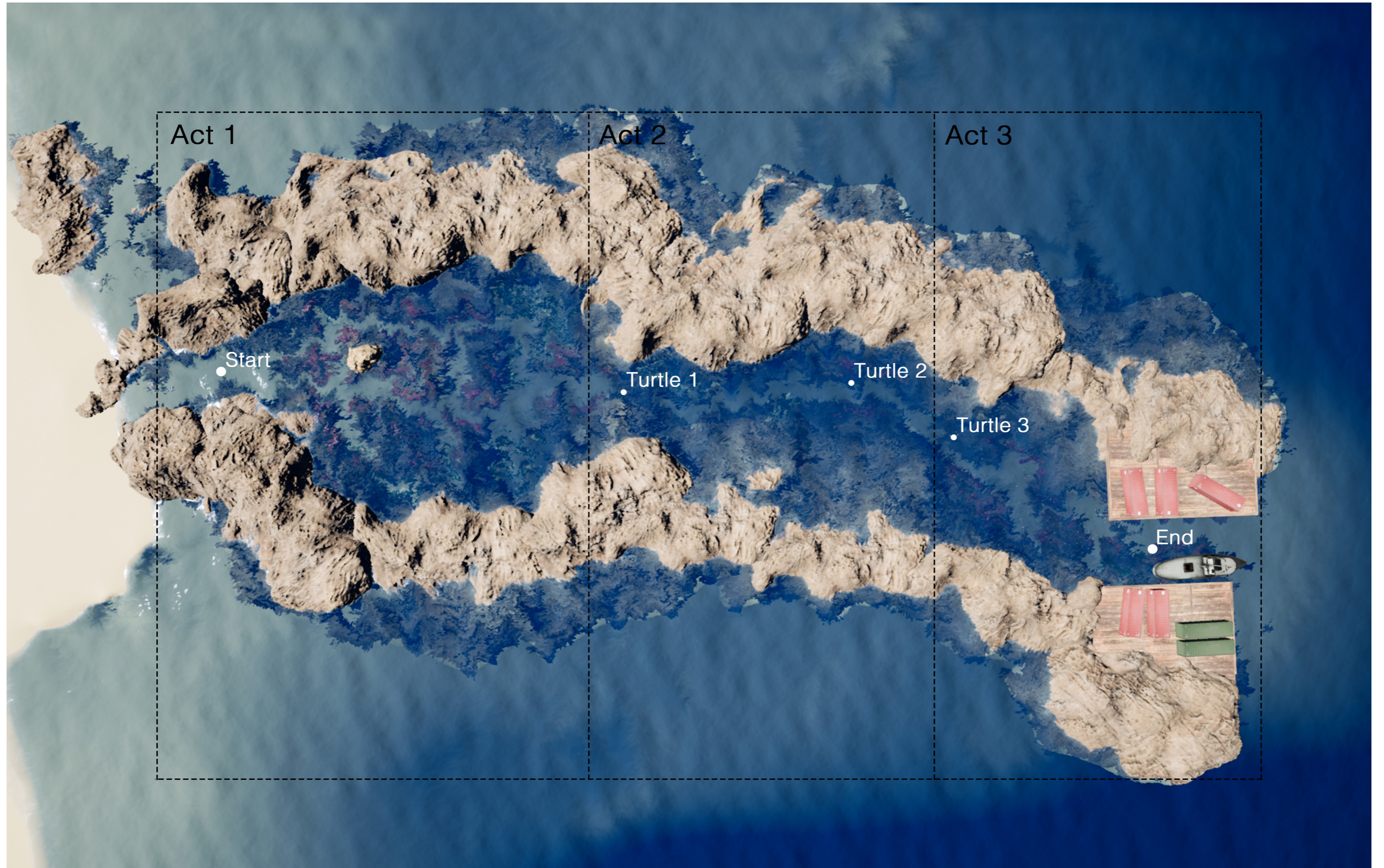


Fig. 103. Final (version two) map of environment, turtle locations and three-act structure regions.

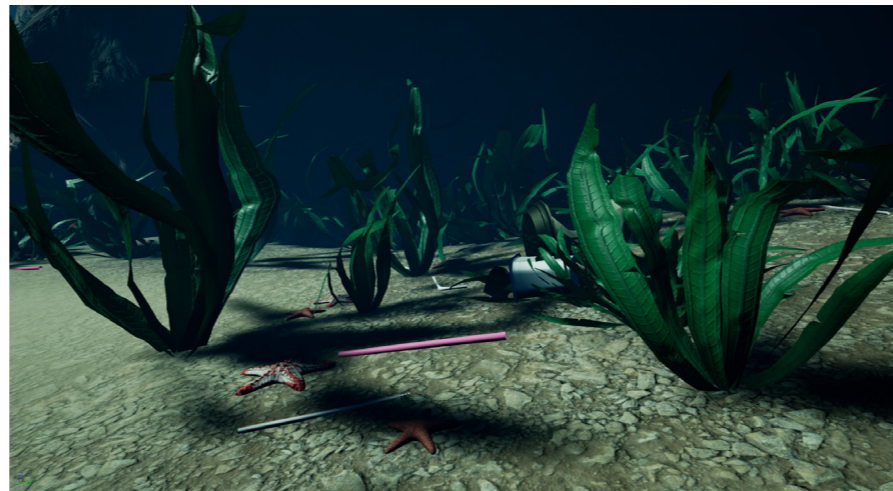
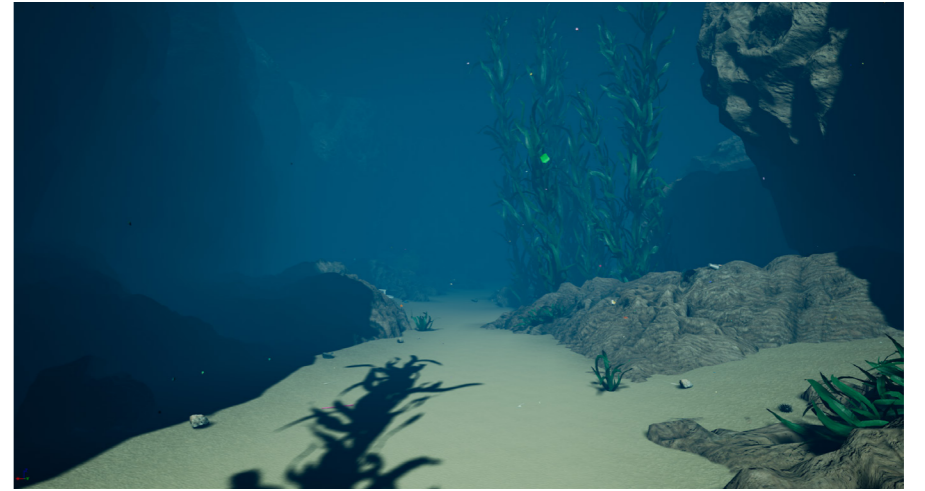
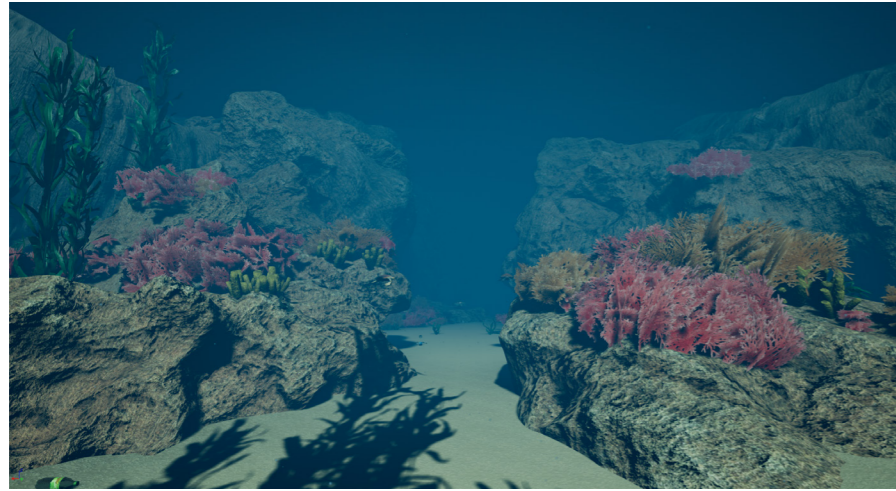


Fig. 104-109. Final perspectives from VR Turtle Experience.

Section 5: Conclusion

Findings

My research has explored the value of eliciting empathy through virtual reality as a means of environmental communication and activism, employing virtual reality, anthropomorphism, first-person perspective and storytelling methodologies. Virtual reality can allow participants to have a sense of immersion and presence. It can provide experiences that are impossible in reality and has allowed me to transport my participants into a marine environment affected by plastic waste to witness the impacts from the perspective of a sea turtle. First-person perspective is important in a virtual reality experience, allowing participants to embody their characters digitally and to form deeper connections with their avatar.

While the interactive narrative design demonstrated promise in creating educational immersive experience, I did encounter some challenges. In a future iteration, I would like to have the experience on tracks (similar to my first iteration), so the participant follows a particular path, but still allow them control of the speed they move. This will help further solve one of the challenges I have had throughout the experience, participants getting lost or confused

about what they are meant to do at the beginning of the experience. This will also make the experience easier to grasp for those who have little to no experience in VR or gaming.

I responded to the user testing focusing on the two design issues. I adjusted the digital space to ensure my participants would not get lost by tightening the space to make the pathways and the direction in which the participant needed to go more clear. I then adjusted the end sequence, which allowed me to enhance the final scene designed to create a more significant response and then transport the participant into another space where I could deliver statistics without any distractions.

Through my research, I hope to contribute a deeper understanding of virtual reality as a tool to communicate environmental issues, to create empathic responses and proenvironmental changes in attitudes and behaviours; especially in today's changing climate. It is important for projects like this to give a sense of urgency of environmental issues and a global push for pro-environmental action. This method of environmental communication through virtual reality, anthropomorphism, empathy, persuasion and storytelling can be

applied to different environmental issues, not just plastic waste in marine environments. For example, this method could be used to experience deforestation from the perspective of a bird or melting ice in the Arctic from the perspective of a polar bear. Virtual reality has the potential of being a tool for environmental activism (Archer and Finger 20). As Christou states "humans learn by having experiences, by interacting with their environment using their senses to derive information from the world" (229).

To conclude, my design demonstrates that virtual reality is a powerful tool for communicating the devastating impact of environmental destruction. In teaching environmental issues through empathetic storytelling within an interactive virtual reality experience, we can create pro-environmental responses.



Fig. 110. My first scuba diving experience: Try Dive at Wellington Regional Aquatic Centre.

References

- Alsever, Jennifer. "Is Virtual Reality the Ultimate Empathy Machine?" *Wired*, Nov. 2015. www.wired.com, <https://www.wired.com/brandlab/2015/11/is-virtual-reality-the-ultimate-empathy-machine/>.
- Ahn, S. J., et al. Experiencing Nature: Embodying Animals in Immersive Virtual Environments Increases Inclusion of Nature in Self and Involvement with Nature. 2016, <https://vhil.stanford.edu/pubs/2016/experiencing-nature-embodying-animals-in-immersive-virtual-environments/>.
- Archer, Dan, and Katharina Finger. Walking in Another's Virtual Shoes: Do 360-Degree Video News Stories Generate Empathy in Viewers? 2018. academiccommons.columbia.edu, doi:10.7916/D8669W5C.
- Arora, Gabo, and Chris Milk. Clouds Over Sidra. 2015. www.with.in, <https://www.with.in/watch/clouds-over-sidra>.
- Brewster, Signe. "Designing for Real Feelings in a Virtual Reality – Designing for Virtual Reality." *Medium*, 10 Aug. 2017, <https://medium.com/s/designing-for-virtual-reality/designing-for-real-feelings-in-a-virtual-reality-41f2a2c7046>.
- Bucher, John K. *Storytelling for Virtual Reality : Methods and Principles for Crafting Immersive Narratives*. Routledge, Taylor & Francis Group, 2018. Internet.
- Christou, Chris. "Virtual Reality in Education." *Affective, Interactive and Cognitive Methods for E-Learning Design: Creating an Optimal Education Experience*, edited by Aimilia Tzanavari and Nicolas Tsapatsoulis, IGI Global, 2010, pp. 228–43.
- Dennis, Danfung, and Eric Strauss. This Is Climate Change: Famine. 2018. www.with.in, <https://www.with.in/watch/this-is-climate-change-famine>.
- . This Is Climate Change: Feast. 2018. www.with.in, <https://www.with.in/watch/this-is-climate-change-feast>.
- . This Is Climate Change: Fire. 2018. www.with.in, <https://www.with.in/watch/this-is-climate-change-fire>.
- . This Is Climate Change: Melting Ice. 2018. www.with.in, <https://www.with.in/watch/this-is-climate-change-melting-ice>.
- Elassar, Alaa. A Baby Turtle Was Found with 104 Pieces of Plastic in Its Belly - CNN. 5 Oct. 2019, <https://edition.cnn.com/2019/10/05/us/turtle-died-after-ingesting-plastic-trnd/index.html>.
- Gall, S. C., and R. C. Thompson. "The Impact of Debris on Marine Life." *Marine Pollution Bulletin*, vol. 92, no. 1, Mar. 2015, pp. 170–79. ScienceDirect, doi:10.1016/j.marpolbul.2014.12.041.
- Gibbens, Sarah. "A Brief History of How Plastic Straws Took over the World." *Environment*, 2 Jan. 2019, <https://www.nationalgeographic.com/environment/2018/07/news-plastic-drinking-straw-history-ban/>.
- Gorisse, Geoffrey, et al. "First- and Third-Person Perspectives in Immersive Virtual Environments: Presence and Performance Analysis of Embodied Users." *Frontiers in Robotics and AI*, 2017. EBSCOhost, doi:10.3389/frobt.2017.00033.
- Harrison, Marissa A., and A. E. Hall. "Anthropomorphism, Empathy, and Perceived Communicative Ability Vary with Phylogenetic Relatedness to Humans." *Journal of Social, Evolutionary, and Cultural Psychology*, vol. 4, no. 1, Jan. 2010, pp. 34–48. 2010-13289-003, EBSCOhost, doi:10.1037/h0099303.

Long, Jessica. "Volunteers Dive in to Help Clean up Wellington Harbour of Rubbish." Stuff, 26 Jan. 2019, <https://www.stuff.co.nz/environment/110184056/volunteers-dive-in-to-help-clean-up-wellington-harbour-of-rubbish>.

Markowitz, D.M., Laha, R., Perone, B.P., Pea, R.D. & Bailenson J.N. (2018). Immersive Virtual Reality Field Trips Facilitate Learning About Climate Change. *Frontiers in Psychology*, 9, DOI=10.3389/fpsyg.2018.02364

Milk, Chris. How Virtual Reality Can Create the Ultimate Empathy Machine. 2015. www.ted.com, https://www.ted.com/talks/chris_milk_how_virtual_reality_can_create_the_ultimate_empathy_machine.

Murray, Janet H. "Not a Film and Not an Empathy Machine." Medium, 27 Mar. 2019, <https://immerse.news/not-a-film-and-not-an-empathy-machine-48b63b0eda93>.

National Geographic. "Sea Turtles." *Animals*, 28 Jan. 2019, <https://www.nationalgeographic.com/animals/reptiles/group/sea-turtles/>.

Parker, Laura. "Straw Wars: The Fight to Rid the Oceans of Discarded Plastic." *National Geographic News*, 23 Feb. 2018, <https://www.nationalgeographic.com/news/2017/04/plastic-straws-ocean-trash-environment/>.

Ritchie, Hannah, and Max Roser. "Plastic Pollution." *Our World in Data*, Sept. 2018. [ourworldindata.org](https://ourworldindata.org/plastic-pollution), <https://ourworldindata.org/plastic-pollution>.

Schoeller, Felix, et al. "Combining Virtual Reality and Biofeedback to Foster Empathic Abilities in Humans." *Frontiers in Psychology*, vol. 9, Feb. 2019. 2019-09598-001, EBSCOhost, doi:10.3389/fpsyg.2018.02741.

Schutte, Nicola S., and Emma J. Stilić. "Facilitating Empathy through Virtual Reality." *Motivation and Emotion*, vol. 41, no. 6, Dec. 2017, pp. 708–12. Springer Link, doi:10.1007/s11031-017-9641-7.

Sea Turtle Biologist. Sea Turtle with Straw up Its Nostril - "NO" TO PLASTIC STRAWS. 2015. YouTube, <https://www.youtube.com/watch?v=4wH878t78bw>.

Sheavly, S. B., and K. M. Register. "Marine Debris & Plastics: Environmental Concerns, Sources, Impacts and Solutions." *Journal of Polymers and the Environment*, vol. 15, no. 4, Oct. 2007, pp. 301–05. Springer Link, doi:10.1007/s10924-007-0074-3.

Shelton, Mary Lou, and Ronald W. Rogers. "Fear-Arousing and Empathy-Arousing Appeals to Help: The Pathos of Persuasion." *Journal of Applied Social Psychology*, vol. 11, no. 4, Aug. 1981, p. 366.

Sherman, William R., and Alan B. Craig. *Understanding Virtual Reality. [Electronic Resource] : Interface, Application, and Design*. Morgan Kaufmann, 2003. Internet, EBSCOhost, <http://ezproxy.massey.ac.nz/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=cat00245a&AN=massey.b3602190&site=eds-live&scope=site>.

Shin, Donghee. *Empathy and Embodied Experience in Virtual Environment: To What Extent Can Virtual Reality Stimulate Empathy and Embodied Experience?* Jan. 2018, pp. 64–73, <https://www-sciencedirect-com.ezproxy.massey.ac.nz/science/article/pii/S0747563217305381>.

Ulrich, Mark. "Seeing Is Believing: Using the Rhetoric of Virtual Reality to Persuade." *Young Scholars in Writing: Undergraduate Research in Writing and Rhetoric*, vol. 9, Sept. 2015, pp. 5–18.

Velux. *The Indoor Generation by VELUX* - YouTube. 2018, <https://www.youtube.com/watch?v=ygHU0mQGuJU>.

"VR for Impact." *VR for Impact*, <https://vrforimpact.com>. Accessed 24 Feb. 2020.

Witmer, B. G., and M. J. Singer. "Measuring Presence in Virtual Environments: A Presence Questionnaire." *Presence: Teleoperators and Virtual Environments*, vol. 7, no. 3, 1998, pp. 225–40. Scopus, Scopus, doi:10.1162/105474698565686.

WWF, Stemming the Tide of Plastics in Our Oceans | Magazine Articles | WWF. 2016, <https://www.worldwildlife.org/magazine/issues/fall-2016/articles/stemming-the-tide-of-plastics-in-our-oceans>.

WWF, Australia. The Lifecycle of Plastics. 19 June 2018, <https://www.wwf.org.au/news/blogs/the-lifecycle-of-plastics>.

List of Figures

- Fig. 1.** Figgener, Christine. "Sea Turtle with Straw up its Nostril." YouTube, uploaded by Sea Turtle Biologist, 10 August, 2015, <https://www.youtube.com/watch?v=4wH878t78bw&t=212s>
- Fig. 2.** Gumbo Limbo Nature Center, Inc. "A baby loggerhead sea turtle was found in Boca Raton, Florida, with plastic in its stomach." CNN, Elassar, Alaa, 5 October, 2019, <https://edition.cnn.com/2019/10/05/us/turtle-died-after-ingesting-plastic-trnd/index.html>
- Fig. 3.** Ford, Monique. "In its first year the Wellington Harbour Clean Up found 40 tonnes of rubbish thrown into the waterway." Stuff, Jessica Long, 26 January, 2019, <https://www.stuff.co.nz/environment/110184056/volunteers-dive-in-to-help-clean-up-wellington-harbour-of-rubbish>
- Fig. 4.** De Thurah, Martin, director. "The Indoor Generation by VELUX." YouTube, uploaded by The VELUX Group, 14 May, 2018, <https://www.youtube.com/watch?v=ygHU0mQGuJU>
- Fig. 5.** National Geographic. "His Epic Message Will Make You Want to Save the World | Short Film Showcase." YouTube, uploaded by National Geographic, narrated by Prince Ea, 10 January, 2017, <https://www.youtube.com/watch?v=B-nEYsyRIYo&t=21s>
- Fig. 6.** Zec, Milica, Winslow Porter, directors. "Tree." 2017, <https://www.treeofficial.com/>
- Fig. 7.** Zec, Milica, Winslow Porter, directors. "Tree." 2017, <https://www.treeofficial.com/>
- Fig. 8.** Dennis, Danfung, Eric Strauss, directors. "This is Climate Change: Feast." Within, 2018, <https://www.with.in/watch/this-is-climate-change-feast>
- Fig. 9.** Dennis, Danfung, Eric Strauss, directors. "This is Climate Change: Melting Ice." Within, 2018, <https://www.with.in/watch/this-is-climate-change-melting-ice>
- Fig. 10.** Arora, Gabo, Chris Milk. "Clouds Over Sidra." Within, 2015, <https://www.with.in/watch/clouds-over-sidra>
- Fig. 11.** Arora, Gabo, Chris Milk. "Clouds Over Sidra." Within, 2015, <https://www.with.in/watch/clouds-over-sidra>
- Fig. 12.** Dennis, Danfung, Eric Strauss, directors. "This is Climate Change: Famine." Within, 2018, <https://www.with.in/watch/this-is-climate-change-famine>
- Fig. 13.** Herrera, Fernanda, Elise Ogle, Tobin Asher, Jeremy Bailenson. "Becoming Homeless: A Human Experience." Virtual Human Interaction Lab, Stanford University, 2018, <https://vhil.stanford.edu/becominghomeless/>
- Fig. 14.** Herrera, Fernanda, Elise Ogle, Tobin Asher, Jeremy Bailenson. "Becoming Homeless: A Human Experience." Virtual Human Interaction Lab, Stanford University, 2018, <https://vhil.stanford.edu/becominghomeless/>
- Fig. 15.** Virtual reality turtle experience prototype (version one) perspective. Holly Downer, 2020.
- Fig. 16.** Design process. Holly Downer, 2020.
- Fig. 17.** Plastic journey map. Holly Downer, 2020.
- Fig. 18.** Multiple perspectives storyboard (Narrative One). Holly Downer, 2020.
- Fig. 19.** Multiple perspectives developed storyboard (Narrative One). Holly Downer, 2020.
- Fig. 20.** Turtle and the plastic bag storyboard (Narrative Two). Holly Downer, 2020.

- Fig. 21.** Opening scene from plastic and the sea turtles storyboard. Holly Downer, 2020.
- Fig. 22.** The opening scene from prototype (version one). Holly Downer, 2020.
- Fig. 23.** Plastic and the sea turtles narrative storyboard (Narrative Three). Holly Downer, 2020.
- Fig. 24.** Nava, Matt, director. "Abzu". Giant Squid, 2016.
- Fig. 25.** Nava, Matt, director. "Abzu". Giant Squid, 2016.
- Fig. 26.** Turtle And The Plastic Bag Narrative Journey Map. Holly Downer, 2020.
- Fig. 27.** Development perspective and map. Holly Downer, 2020.
- Fig. 28.** Prototype (version one) perspective and map. Holly Downer, 2020.
- Fig. 29.** Fish particle system example. Holly Downer, 2020.
- Fig. 30.** Fish on tracks example. Holly Downer, 2020.
- Fig. 31.** Fish characters example. Holly Downer, 2020.
- Fig. 32.** Plastic spawners delivering plastic every minute into the water below. Holly Downer, 2020.
- Fig. 33.** Prototype (version one) plastic delivery from the boat into the final scene. Holly Downer, 2020.
- Fig. 34.** Statistic video frame. Holly Downer, 2020.
- Fig. 35.** Statistic video in experience. Holly Downer, 2020.
- Fig. 36.** Final scene for experience prototype (version one) functionality diagram. Holly Downer, 2020.
- Fig. 37.** Plastic objects model in Maya, textures created in photoshop and exported into experience. Holly Downer, 2020.
- Fig. 38.** Plastic particle systems. Holly Downer, 2020.
- Fig. 39.** Ocean dust particle system. Holly Downer, 2020.
- Fig. 40.** Turtles in plastic bags modelled in Maya and exported into VR experience. Holly Downer, 2020.
- Fig. 41.** Plastic bag and debris in VR experience. Holly Downer, 2020.
- Fig. 42.** Me scuba diving in Wellington's Taputeranga Marine Reserve, New Zealand. Holly Downer, 2020.
- Fig. 43.** Dive location: Kau Bay, Wellington, New Zealand. Holly Downer, 2020.
- Fig. 44.** Dive location: Taputeranga Marine Reserve, Wellington, New Zealand. Holly Downer, 2020.
- Fig. 45.** Dive log. Holly Downer, 2020.
- Fig. 46-57.** Stills from scuba diving experience in Wellington's Marine Reserve, New Zealand. Holly Downer, 2020.
- Fig. 58.** Prototype (version one) map of environment, turtle locations and three-act structure regions. Holly Downer, 2020.
- Fig. 59.** Injured turtle one (straw in nostril). Holly Downer, 2020.
- Fig. 60.** Injured turtle two (plastic bag handle around the neck). Holly Downer, 2020.
- Fig. 61.** Injured turtle three (plastic bag around the neck). Holly Downer, 2020.
- Fig. 62-67.** Prototype (version one) perspective images. Holly Downer, 2020.
- Fig. 68.** Prototype (version one) perspective image. Holly Downer, 2020.

- Fig. 69.** Photo from user testing. Holly Downer, 2020.
- Fig. 70.** Photo from user testing. Holly Downer, 2020.
- Fig. 71.** Delivery of statistics through written text in the digital environment. Holly Downer, 2020.
- Fig. 72.** Plastic chair in VR experience. Holly Downer, 2020.
- Fig. 73.** User testing journey map. Holly Downer, 2020.
- Fig. 74.** Transitional space between the clean coral reef and the dense plastic area referred to as Cave. Holly Downer, 2020.
- Fig. 75.** User testing survey results for question: How immersed were you in the space? Holly Downer, 2020.
- Fig. 76.** User testing survey results for question: What emotions did you feel from the experience? Holly Downer, 2020.
- Fig. 77.** User testing survey results for question: How likely are you to reduce consumption? Holly Downer, 2020.
- Fig. 78.** User testing survey results for question: How likely are you to research further into plastic pollution in marine environments? Holly Downer, 2020.
- Fig. 79.** User testing survey results for question: Do you feel motivated to act on what you saw? Holly Downer, 2020.
- Fig. 80.** Design output (version two) perspective. Holly Downer, 2020.
- Fig. 81.** Prototype (version two) plan sketches. Holly Downer, 2020.
- Fig. 82.** Prototype (version two) three-act structure narrative plan. Holly Downer, 2020.
- Fig. 83.** Container model making. Holly Downer, 2020.
- Fig. 84-89.** Final message sequence. Holly Downer, 2020.
- Fig. 90-97.** Final event sequence. Holly Downer, 2020.
- Fig. 98.** Plastic six-pack can holder Model. Holly Downer, 2020.
- Fig. 99.** Plastic six-pack can holder particle system. Holly Downer, 2020.
- Fig. 100.** Injured turtle with a plastic six-pack can holder (turtle two). Holly Downer, 2020.
- Fig. 101.** Final (version two) injured turtle placement (turtle one). Holly Downer, 2020.
- Fig. 102.** Final (version two) turtle placement (turtle three). Holly Downer, 2020.
- Fig. 103.** Final (version two) map of environment, turtle locations and three-act structure regions. Holly Downer, 2020.
- Fig. 104-109.** Final perspectives from VR Turtle Experience. Holly Downer, 2020.
- Fig. 110.** My first scuba diving experience: try dive at Wellington Regional Aquatic Centre. Holly Downer, 2020.

Appendices

Contents:

127	Participant Consent Form
128	Information Sheet
130	Survey One Questions
132	Survey One Results
133	Survey Two (Questionnaire Two) Questions
136	Survey Two Results



PARTICIPANT CONSENT FORM

Name: _____

email: _____

Turtle Experience

Constructing Empathetic Spatial Narratives Through Virtual Reality
by Holly Downer

This consent form will be held for a period of five (5) years

I have had the details of the 'Constructing Empathetic Spatial Narratives Through Virtual Reality' project explained to me and/or I have read the information sheet. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

Please circle one option for each clause...

- I **agree/do not agree** to the documentation of my participation in this research.
- I **agree/do not agree** that my participation in this research can be attributed to me.
- I **agree/do not agree** to the audio recording of my participation in this research. **(N/A)**
- I **agree/do not agree** to the photography/videography of my participation in this research. **(N/A)**
- I **wish/do not wish** to have audio, video or photographic records sent to me. **(N/A)**
- I **would like/would not like** a copy of this document
- I am **willing/not willing** to be contacted

I agree to participate in 'Constructing Empathetic Spatial Narratives Through Virtual Reality' under the conditions I have outlined above.

Signature: _____ **Date:** _____

Full Name - printed _____

We take your privacy seriously. Your contact information will never be used for any other purpose other than to contact you about your participation in this production or design research. This Research Ethics Consent Sheet is available at <http://bit.ly/2Ug9mrv>

Name: _____

email: _____

Turtle Experience

Constructing Empathetic Spatial Narratives Through Virtual Reality
by Holly Downer

INFORMATION SHEET

This information is valid for a period of five (5) years

Researcher Introduction

Hi, I am Holly Downer, currently studying Master of Design at Massey University College of Creative Arts. This project is a Virtual Reality Experience designed to create awareness of plastic pollution in marine environments. The Virtual Reality experience transports the participant into a digitally constructed marine environment so that they can experience plastic pollution in this context.

Project Procedures

This is a prototype of my experience to test and receive feedback from participants.

Participant Recruitment

Participants will be recruited through social media sites. They will have a range of virtual reality experiences and environmental awareness to see how it impacts participants differently in regards to their previous experience/knowledge.

Participant Involvement

Participants are invited to partake in a survey. After the survey they will be invited to participate in the virtual reality experience where they will deliver feedback on the experience through another survey.

Data Collection

Data will be collected from a before and after survey. Results from the surveys will be discussed in the project's thesis.

Participant's Rights:

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- Decline to answer any particular question;
- Withdraw from the study (no specific timeframe);
- Ask any questions about the study at any time during participation;

- Provide information on the understanding that your name will not be used unless you give permission to the researcher;
- Be given access to a summary of the project findings when it is concluded.
- Ask for the audio/videotape to be turned off at any time during the research.

Project Contacts

Please feel free to contact me at any stage if have any questions about the project.

Holly Downer

Contact Number: 027 828 4735

Email: hollydowner61@gmail.com

Academic and Research advisor

Stuart Foster

Email: s.t.foster@massey.ac.nz

We take your privacy seriously. Your contact information will never be used for any other purpose other than to contact you about your participation in this production or design research.

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named in this document are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you want to raise with someone other than the researcher(s), please contact Dr Brian Finch, Director (Research Ethics), email humanethics@massey.ac.nz. The above template is available here <http://bit.ly/2v8vb20>

Survey

Please read the following before completing the survey.

You are invited to participate in the research project 'Constructing Empathetic Spatial Narratives Through Virtual Reality' by completing the following survey. The aim of this survey is to gain an insight of people's awareness on plastic pollution in marine environments. The survey should take approximately 2 minutes and you must be 16 or older to complete this survey.

Please leave your name and email if you wish to participate in testing my virtual reality experience at Massey University Wellington. If you wish to remain anonymous, do not leave your name and email at the end of the survey. If your participation is anonymous, your contribution cannot be retrieved after it has been submitted.

The project is being carried out by Holly Downer a Master of Design candidate at Massey University's School of Design at the College of Creative Arts. Stuart Foster, s.t.foster@massey.ac.nz is the academic supervisor and has reviewed and approved this research enquiry on behalf of Massey University's Human Ethics Committee. Please contact either of these people to discuss any concerns you may have about your or any participation in this research project.

Thank you for your time,
Holly Downer

Any questions please contact me via email at hollydowner61@gmail.com

* Required

1. *

Mark only one oval.

I have read through the consent information above and agree to participate in this questionnaire

2. **Age** *

Mark only one oval.

- 16 - 24 years old
 25 - 34 years old
 35 - 44 years old
 45 - 54 years old
 55 - 64 years old
 65 years or older

3. **How many Virtual Reality Experiences have you had?** *

Mark only one oval.

- Never
 1 to 3
 3 and above

4. **Do you read or watch videos on environmental issues?** *

Mark only one oval.

- Yes
 Sometimes
 Never

5. **Are you aware of plastic pollution in marine environments?** *

Mark only one oval.

- Yes
 No

6. **Do you avoid plastic packaging when making purchases?** *

Mark only one oval.

- Yes
 No
 Sometimes

7. **How often do you purchase beverages in a plastic bottle in a week? (for example milk, water, juice, soft drinks, etc)** *

Mark only one oval.

- None
 1-3
 5-7
 8 or more

8. **Are you concerned about the amount of waste you produce?** *

Mark only one oval.

- Yes
 No
 Sometimes

9. **Do you recycle?** *

Mark only one oval.

- Yes
 No
 Sometimes

Thank you for completing this questionnaire

Are you interested in participating in testing Virtual Reality Experience? If 'yes' and you live in Wellington please supply name and email below.

10. **Name:**

11. **Email:**

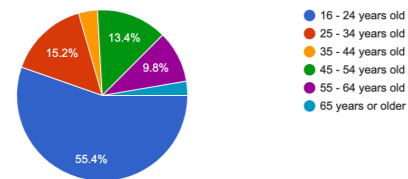
Questionnaire One (Survey One) Results

23/01/2020

Questionnaire Part 2

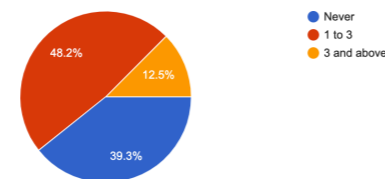
Age

112 responses



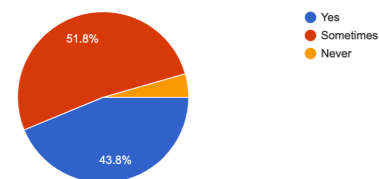
How many Virtual Reality Experiences have you had?

112 responses



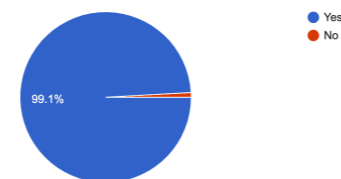
Do you read or watch videos on environmental issues?

112 responses



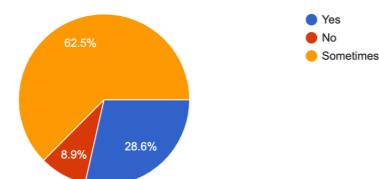
Are you aware of plastic pollution in marine environments?

112 responses



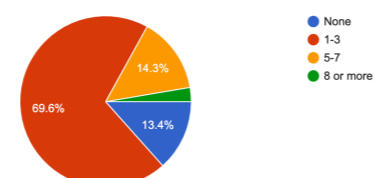
Do you avoid plastic packaging when making purchases?

112 responses



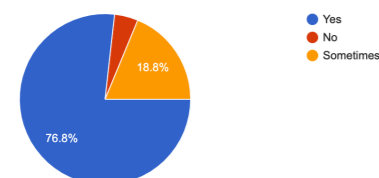
How often do you purchase beverages in a plastic bottle in a week? (for example milk, water, juice, soft drinks, etc)

112 responses



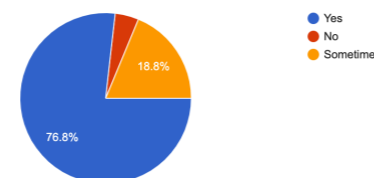
Are you concerned about the amount of waste you produce?

112 responses



Do you recycle?

112 responses



Questionnaire Part 2

Thank you for participating in Virtual Reality Experience. This questionnaire is designed to give an indication of how you interpreted the experience.

This questionnaire is anonymous and should take approximately 5 minutes.

Please answer the following questions.

* Required

1. Who were you in the experience? *

2. What happened in the experience? *

3. Did you feel in control of the experience and of what happened? *

Mark only one oval.

- Yes
 No
 Other: _____

4. Why? *

5. How immersed were you in the space? *

Mark only one oval.

- 1 2 3 4 5 6 7
 Not Immersed Highly Immersed

6. How long did the experience feel? *

7. What emotions did you feel from the experience? *

Check all that apply.

- Angry
- Anxious
- Boredom
- Compassion
- Concerned
- Disgust
- Empathy
- Confusion
- Excitement
- Fearful
- Grief
- Happy
- Joy
- Interest
- Sad
- Surprised
- Sympathy
- Worried
- Other: _____

8. What event(s) or moment(s) provoked these emotions? *

9. How likely are you to reduce plastic consumption? *

Mark only one oval.

	1	2	3	4	5	6	7	
Low	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High

10. How likely are you to research further into plastic pollution in marine environments? *

Mark only one oval.

	1	2	3	4	5	6	7	
Low	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High

11. Do you feel motivated to act on what you saw? (for example donate to charity, participate at beach clean ups, etc) *

Mark only one oval.

- Yes
- No
- Other: _____

12. How comfortable were you during the experience? (for example motion sickness) *

13. Any further comments? *



Questionnaire Two (Survey Two) Results

Who were you in the experience?	What happened in the experience?
A turtle	I swam around a coral reef, got a bit lost, followed another turtle, then found a chair and then started to see plastic in the water, found a boat which was the source of that plastic.
Turtle	Found heaps of rubbish
Remy Lei Dai	I felt real, especially the sense of direction and gravity
Turtle	Was swimming through a bay that was polluted with plastic
Turtle	I swam around, saw some wildlife, passed by some rubbish.
Turtle	Swim
A turtle	I swam around as a turtle.
Turtle	I was swimming and I was seeing all the nice coral and other turtle friends, and then I started seeing rubbish appearing more and more until I came to cliff which had writing on it and rubbish falling down in bigger quantities
A turtle	I swam around going deeper into the ocean, as I went deeper there were more and more bits of trash floating and on the ocean floor along with dead or hurt turtles or ocean life.
Aaron Gattoes	VR-testing
The turtle	Swimming through the ocean, eventually finding rubbish
A turtle	Swam through the ocean and encountered other sea animals and lots of rubbish
The turtle	I was experiencing being turtle and was able to see what life was like swimming around in the sea. I could see rubbish being tipped into the sea and the turtle swimming around it.
A turtle	I swam around and saw pollution in the water
a turtle	swam in the ocean, exploring having a grand old turtle time but everything kept getting more polluted the further I went
A Turtle	Swam throughout a reef encountering more plastic as I progressed
A turtle	Explored a section of the ocean that became more and more rubbish
I was a Turtle	I made my way through the ocean, which began to get filled with more and more rubbish
Turtle	Swimming around a nice clean safe environment and then into an environment damaged by plastic pollution. Gave a sense of danger which the pollution causes.
Sally the sea turtle	My day of peacefully swimming amongst my fellow turtles was ruined by plastic pollution :(
Did you feel in control of the experience and of what happened?	
I felt in control of my actions as the turtle, however I was quite lost in the reef & potentially could have just swim around in circles if I wasn't promoted	
yes	
yes	
yes	
Felt a little frustrated with my ability to see.	
yes	
yes	
Somewhat	
No	
yes	
No	
yes	
yes	
yes	
No	
yes	
No	
yes	
yes	

Why?	What emotions did you feel from the experience?
I wasn't quite sure of the direction, until I realised what I was supposed to find	Concerned;Fearful;Grief;Interest
By the use of VR being able to move around and feeling like you are amongst it helped big time	Anxious;Concerned;Disgust;Empathy;Confusion;Excitement;Interest;Surprised;Worried
I touched through them	Fearful;Interest;Surprised
Good control on the graphics	Concerned;Joy;Interest;Surprised;Sympathy
Just wanted to know what I was looking at a bit more.	Interest;Intrigue
I controlled the turtle	Concerned;Sympathy
I could move around, up and down. I didn't feel restricted in where I could go. The rocks were good to use as walls, but I had gone around the wrong way so it took me a bit of time to find where I was supposed to go.	Concerned;Disgust;Empathy;Excitement;Interest
I was in control of where I wanted to go but there were limitations like not leaving the water. Although I could go where I wanted there was a specific path that I wanted me to take where scripted events that were outside of my control happened.	Angry;Compassion;Concerned;Disgust;Empathy;Excitement;Fearful;Joy;Surprised;Sympathy
I instinctively wanted to pick up the few pieces of rubbish I saw initially but as a turtle - was unable to. The more rubbish that started appearing the more I felt helpless. It made me feel uncomfortable	Concerned;Empathy;Sad;Surprised;Uncomfortable
I could control where I went and what I could see	Compassion;Concerned;Excitement;Interest;Surprised;Sympathy
Felt like a ride	Fearful
The character moved where I directed it, I was experiencing the space+ the sound correlated with the turtles strokes	Compassion;Concerned;Empathy;Interest;Sad;Sympathy;Worried
The controller allowed you to be in control	Concerned;Fearful;Sad;Worried
I felt in control fully.	Concerned;Empathy;Fearful;Sympathy;Worried
I was able to control where I went and the environment seemed very large so I was able to go all over.	Angry;Anxious;Concerned;Empathy;Fearful;Grief;Sad;Worried
I was a turtle and I couldn't help the other turtles I could only watch them suffer	Compassion;Concerned;Empathy;Excitement;Happy;Interest;Sad;Sympathy
The movement was quite fluid and I managed to go where I wanted to	Concerned;Interest;Sympathy
Because I could move at my own pace through the environment	Concerned;Sympathy
I couldn't stop the increase of plastic or save the sea life affected	Compassion;Concerned;Empathy;Excitement;Interest
Controls were open. Space didn't feel small giving a sense of more control in what to experience. Gave a sense of adventure in the controls.	Concerned;Empathy;Sad;Surprised;Uncomfortable
Maybe too much so. I was able to move straight up and down	Compassion;Concerned;Excitement;Interest;Surprised;Sympathy
It felt a bit short. It was really cool and I would have liked to see more. But I understand that you need something a bit shorter to keep peoples attention.	Fearful
It felt quick but also a good amount of time to go exploring.	Compassion;Concerned;Empathy;Interest;Sad;Sympathy;Worried
Quite long - maybe 10 minutes	Concerned;Fearful;Sad;Worried
I enjoyed the experience so it didn't feel very long. I got to explore the areas well	Concerned;Empathy;Fearful;Sympathy;Worried
10mins	Angry;Anxious;Concerned;Empathy;Fearful;Grief;Sad;Worried
Very short but also a good length for how much there was in the experience	Compassion;Concerned;Empathy;Excitement;Happy;Interest;Sad;Sympathy
Good length. Maybe 3 mins	Concerned;Sympathy
5 minutes	Compassion;Concerned;Empathy;Grief;Interest
5 minutes	Compassion;Concerned;Excitement;Joy;Interest;Surprised;Sympathy
Quite fast, I should have explored more	Concerned;Sympathy
2-3 minutes	Compassion;Concerned;Empathy;Grief;Interest
It length of the experience was perfect. Not too long and not too short.	Compassion;Concerned;Excitement;Joy;Interest;Surprised;Worried
5 minutes	Concerned;Interest;Sympathy;Worried
Pretty much on point length	

What event(s) or moment(s) provoked these emotions?	How likely are you to reduce plastic consumption?
Finding the chair was a prominent moment where I was shocked, I think it was to do with the scale and the out of usual context nature of the chair	7
When the rubbish started coming around, the dead turtle and the use of text at the end and seeing the rubbish dumped.	7
When I across the seeds, have strong emotions at that moment	7
The corals invoked joy but the Marine life invoked sympathy	4
The whole experience. The unravelling of the experience.	4
Seeing the turtles with straw and bag	1
I was really interested/ excited when looking at the environment. As I got further along and saw the rubbish and turtles I became more concerned and disgusted with all the rubbish.	6
Most negative emotions were triggered by the turtles being impacted by the pollution as well as the pollution itself. Positive emotions came from the beginning interacting with other animals and the environment. Some of the	4
When the surrounding landscape changes from being nice and natural to having pieces of rubbish, I feel these emotions the most when I got to the end where the rubbish was most dense	6
Seeing the hurt or dead turtles along with all the trash floating around	7
Definitely seeing rubbish in our oceans	7
Seeing other sea life caught up in litter- (turtle in the fish net)	7
When you swam through all the rubbish and you could hear it as it knocked past	5
Seeing rubbish everywhere and more rubbish being dumped	6
The rubbish tumbling into the water from above and the poor dead turtles	5
It was beautiful and exciting exploring the ocean but I didn't like seeing all the turtles in trouble	5
Seeing the other turtles caught in plastic	5
The dying/dead turtles	4
The dying turtles and the fact that I couldn't do anything about it	5
Beginning region Suffocating turtles. Rubbish. Ending remarks.	5
As plastic started to appear - this worked really well. Also seeing the boat	5

How likely are you to research further into plastic pollution in marine environments?	Do you feel motivated to act on what you saw? (for example donate to charity, participate at beach clean ups, etc)
6	Yes
5	Yes
7	Yes
4	Yes
5	I have been interested in beach clean-up participation.
1	No
2	I would like to help, but its hard to be motivated to act when you dont know what the next steps are.
4	No
7	Yes
6	Yes
7	Yes
6	Yes
6	Yes
5	I feel more inclined not to buy as much plastic
4	Yes
3	Yes
5	Yes
5	Yes
5	Yes
6	Yes
5	Yes

How comfortable were you during the experience? (for example motion sickness)
I did feel slightly motion sick, but I also understand that was because of the swimming feeling, like being in a boat so that was successful
Dizzy at the end
A little bit dizzy
Slight dizziness
Fine.
Good
Really comfortable. I was a bit disorientated at first when I stepped back but I then got the hang of it.
I was fine.
I felt slightly nauseous, but mostly from turning my head too much wanting to see everything
No motion sickness, was very comfortable exploring
Not bad
Took a minute to get used to the motion
Very comfortable
A little motion sickness. The experience was a good length so there wasn't enough time to get motion sickness
Totally comfortable as I had control
pretty comfortable
I was quite comfortable
Very comfortable
I felt completely comfortable
Very Comfortable
No motion sickness

Any further comments?
Amazing experience! I think some kind of guides, or aim at the beginning to know you are searching for a boat etc could be helpful but then that might change the intention.
Very great work with the VR stuff.
No
Good work Hollie
Blurriness is a little frustrating. I understand why it is there. I had trouble seeing the message. It was gone to fast. Or it was too blurry.
Great sound
Great setting - although, the experience felt a little slow to get started.
I didn't get the emotional response I expected. I wanted to feel more angry about it. So maybe some more work on the emotional response is needed. Is there opportunity to show a little more suffering. Some issues with going in the right direction.
Na
The words were really large as you got close. You had to move your head a lot to read it all. Maybe some sort of scaling would be good. Also I wanted to continue past the words and I almost missed it.
VR is fun, straws are dumb.
It was well thought out and prompted further interest into this problem
Really great experience! I enjoyed being able to explore the ocean and see the effect that trash has on the ocean and turtles, almost first hand
Not really really enjoyed the experience
I missed the writing at the end :)
It was very good! I feel could maybe have some more rubbish that is a bit bigger? Maybe at one point the turtle could get stuck in a plastic bag or something?
Very cool experience, a talking voice would be cool
Great experience, very moving, only issue was not being able to back up to read text (possibly smaller text would work as well)
n/a
This conveyed the message of marine pollution very clearly
None
It looked very realistic and was enjoyable while also giving a good message
Not at this time.
I think the end text appeared when I wasn't looking at it, so I didn't have time to catch the full message