Virtualising the real: a virtual reality contemporary sculpture park for children

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This paper discusses a virtual reality experience for a contemporary sculpture park, Jupiter Artland, developed in Minecraft targeting 9-11-year-old children. Issues of fidelity, realism and authenticity are considered, examining the use of Minecraft to create visual representations loosely coupled with reality that generate affective responses. We discuss the build of our virtual sculpture park outlining our approach to creating a facsimile of the sculpture park through adopting practices from the Minecraft community and refining and improving the artworks and experience informed by a class of 9-10 year old children. Using the real and virtual sculpture parks we explore the impact of engaging with the real before the virtual Jupiter Artland and vice versa, with the results from a three class study outlined in this paper.

Introduction

This paper focuses on the development and evaluation of a virtual reality sculpture park developed with, and for, Jupiter Artland, a contemporary sculpture park on the outskirts of Edinburgh. Jupiter Artland has a mission "*to get every child in Scotland to visit and experience Jupiter Artland for free.*" As part of this outreach, Jupiter Artland is exploring methods for taking the sculpture park to remote communities including through a virtual representation. In addition, Jupiter Artland aims to use this virtual environment as part of a mixed reality experience in situ.

Building a virtual facsimile of Jupiter Artland is not simply an attempt to recreate the environment and its artworks, but further an attempt to recreate affective responses to the artworks in a virtual space. Knowing how to approach and discuss contemporary art is a challenge in itself (Ward 2014). Using a virtual Jupiter Artland in the classroom provides a means by which the Jupiter Artland Learning Foundation can engage young

people in discussions about art. and act as the basis of creative exercises. This is similar to how the Foundation team use Jupiter Artland itself to trigger creative exercises when on site, we hope that a virtual Jupiter Artland can afford similar exercises remotely. Our aims were three-fold. Firstly, to build a virtual facsimile of an extraordinary real-world environment that we can exploit for investigating virtual and mixed reality experiences with children. Secondly, to explore the efficacy of a classroom based virtual experience as a substitute for, or introduction to, visiting Jupiter Artland. Thirdly, to create a modifiable platform to enable us to understand the constraints and opportunities of a virtual sculpture park as a means for facilitating exercises in contemporary art with children.

Virtualising Jupiter Artland

Jupiter Artland is a contemporary sculpture park displaying realised commissioned proposals from invited artists. Artworks are typically large scale and aim to have a significant impact on visitors. Artists spend time in Jupiter Artland and produce work specifically for a chosen space within the grounds. Thus, it is not simply the sculptures that are significant but also their placement within the landscape and in relation to each other.

In creating virtual Jupiter Artland our constraints included limited time, budget and that users would access it using everyday non-immersive technology, such as phones and laptops. In addition, we had the additional requirement that our virtual Jupiter Artland would also be used in a mixed reality experience in situ. Thus, the virtual experience needed to provide a distinct, yet complementary alternative to the physical reality in order that it maintained relevance for a collocated mixed reality experience. It was important to us that the future project would afford children a meaningful comparable experience in the real, the virtual and the mixed simultaneously.

There is great diversity in the fidelity, authenticity and visual realism seen both in non-immersive and immersive virtual reality. The creation of authentic, realistic virtual representations of physical places has a high cost, both in capturing and displaying the content. Realistic immersive virtual realities such as video-based virtual reality, for example in Muru in Wonderland, (Jang, Baik and Ko 2016) and accurately mapped real world objects and spaces, such as for the Ionian Islands (Komianos, Kavvadia and Oikonomou 2014) aim to, and effectively, replicate the real. However, at the opposite end of the spectrum to authentic visual realism, there have also been considerable efforts to provide virtual environments that do not attempt to create experience through a realistic aesthetic, but instead through an approximation of the real.

In support of non-realistic virtual representations, Turner and her colleagues (2016) argue that it is necessary for Virtual Reality environments to be less realistic to allow the user to fill in the gaps, a process they argue to be guided by make-believe. They tell us that "*schema are held to organize our knowledge of the world and scaffold encounters with new situations and information.*" The 'gaps' or imperfections with reality are filled in through the human ability to employ imagination to 'act as though' or pretend something is real when it is not, be that setting, object or premise. This ability is widely exploited in fiction, theatre, films and games. Pretending is a skill developed in childhood and is an important part of the ability to play (Walton 1990), with play enabling us to imagine directly experiencing certain events whilst in reality these events are not occurring. Play, pretence and make-believe enable us to engage with imperfect realities or to accept an alternative reality loosely coupled with the real. Walther-Hansen and Grimshaw (2016) provide further support for non-realistic representations arguing that perception of an environment is constructed by the

participant in a process that takes into account the salience of the data provided, with focus "*not the careful simulation of sensation from actuality (thus 'realism') but providing the potential to weave multimodal and 'salientful' relationships between the sensory stimuli delivered by the virtual world.*"

Of these loosely coupled virtualities, where the virtual space reflects but does not accurately replicate the real space and that focus on salience rather than realism, the most successful has been Minecraft. Minecraft has been used extensively for the creation of fantasy spaces. Similar to Lego, Minecraft lends itself to creating a replication of the real world, with a wealth of Minecraft virtualisations of real spaces (Guthrie 2016). This includes Minecraft countries - Denmark (Farokhmanesh 2014), cities - Mdina in Malta (Formosa 2014) and museums - the Tate (Styles 2016). Via the planetminecraft community, users are provided with a wide range of cities, places and buildings. In his review of Minecraft, (Quiring 2015) notes that for the Minecraft users the digital places are real and meaningful, both within and beyond the virtual space. Minecraft has become a significant part of the virtual experience and culture for many children, offering children a game world, where players build and construct. It has successfully been used for teaching (Tromba 2013), to improve neighbourhoods (Andrade, Sena, and Moura 2016) and to interpret art (Styles 2016) and has been shown to be a successful medium for engaging and co-designing with young people (Walsh, Donahue, and Pease 2016).

Using Minecraft to create the virtual Jupiter Artland met our requirements across several dimensions. The costs of using Minecraft are low, creation is rapid and its use does not require additional devices, with interaction via phone, tablet or screen. Minecraft facilitates loose coupling, with representations tending to focus on the most

salient and engaging elements of the real. Minecraft is also a popular choice extensively used by the target age group, offering particular potential for novel virtualisations.

Crafting Jupiter Artland in Minecraft

Minecraft reduces the cost and effort in building a virtual world, however, creating the extensive virtual Jupiter Artland still required significant effort in data capture and building. Using maps, surveys and 3D scanning equipment we created initial versions of the artworks and of Jupiter Artland. Working with curators and members of educational outreach staff at Jupiter Artland, we prototyped and refined a virtual Jupiter Artland, before engaging with children. Staff from the education foundation have an in depth understanding of working with children in their exploration of contemporary art. By working closely with them, we were able to discuss fidelity issues and trial possible solutions.

Although Minecraft reduces visual realism it does enable the creation of geographically accurate virtual environments, with dimensions to scale, providing realistic distances, heights and depth. The world we created conforms geographically to Jupiter Artland, with works placed in the area they occupy in the real world, see figure 1.

Figure 1. Jupiter Artland paper map and Minecraft map

Maintaining an accurate geography offers particular benefits for virtual Jupiter Artland. It adds authenticity to the experience, with the virtual facsimile consistent and coherent with the real world, as with Jencks' Cells of Life, see figure 2. Using an accurate geography also allows for a blurring of realities, a novel transition between the real and

virtual, with visitors to virtual Jupiter Artland able to use the paper map of the real in order to navigate the virtual, as in figure 1.

Figure 2. Cells of Life at Jupiter Artland and in Minecraft

Accurately recreating the geography of Jupiter Artland also provided us with spaces that are often inaccessible when in real space. For example, the park is dominated by the private home of the owners and curators, Robert and Nicky Wilson. This building is not accessible to the public. We recreated an accurate rendition of the exterior of the house in a similar material to its distinctive orange stone. After discussion we decided that as it was a space that would not be visited in the real world that we would leave it empty. This then allows the virtual visitor to imagine the interior of the house, much as they would in the real world. However, by downloading a copy of the Minecraft world, a virtual visitor is then empowered to fill the house with whatever they wish.

A particular benefit from providing an accurate geography is that it makes the virtual space sustainable and extendable, consistent with the real space. Jupiter Artland's prolific curation schedule results in new works regularly being commissioned and created in the real world. Geographical accuracy significantly facilitates the incorporation of new works into the virtual world.

Entry to a Minecraft environment is at spawn point set by the developer. We set our virtual entry or spawn point at the entry gates of Jupiter Artland, with virtual visitors starting at the same location as in the real world. The entry gate is where cars enter the park and then traverse a driveway which passes through one of the larger and more impactful sculptures, Charles Jencks Cells of Life (figure 2). We chose the gates

because walking along the path in Minecraft provides a similar experience to driving up the driveway.

Crafting Artworks in Minecraft

The environment of Minecraft objects means that it is impossible to create a true facsimile, with objects having a pixelated look due the relative size of Minecraft blocks. However, styles and approaches have emerged in Minecraft that overcome such constraints. A significant part of the experience of Minecraft culture is looking at constructions other players have made, particularly on YouTube (Dredge 2014; Flint and Turner 2016).

Such sharing, along with how to books and online tutorials, have resulted in styles and practices within Minecraft that respond effectively and innovatively to the challenges of the format. We refer to these approaches as Minecraft Expressionism, highlighting that Minecraft builders reject the ideology of realism aiming instead to provoke emotional and personal responses and reactions to something that differs from a replication of the real. In creating virtual Jupiter Artland, we embraced this Minecraft Expressionism, treating the constraints of Minecraft as an opportunity to develop an original experience of interacting with non-visually realistic artworks and sculptures.

Some sculptures in Jupiter Artland are of giant proportions in real space. However, whilst Minecraft does have restrictions on height, none of our sculptures broke this limit. For example, Parker's Landscape with Gun and Tree, an installation of a facsimile of one of the owner's shotguns enlarged to mammoth proportions and propped against a tree "*as if momentarily left by an absent-minded games keeper*" could be readily replicated to scale in Minecraft.

Minecraft Expressionism results in virtual representations that aggregate and reduce features, focusing on the salient and most meaningful or affective elements of the

representation. For example, Minecraft Expressionism can often be seen through oversized and simplified structures. Following this approach, when we virtualised Laura Ford's Weeping Girls which in the real world is a series of "*5 little girls dressed up as sculptures in positions of high drama which animate the landscape they inhabit*", we recreated this in the Minecraft world as one oversized sculpture, see figure 3. Integrating all 5 girls into a single exaggerated structure aiming to provide a novel virtualisation that retains the salience and emotional impact of the sculpture.
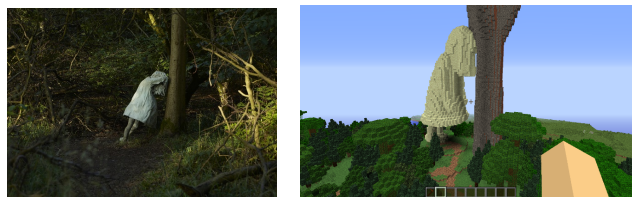

Figure 3. Weeping Girls at Jupiter Artland and in Minecraft

Although some artworks were constructed manually, for many of the artworks we used 3D scans as a basis for the Minecraft construction, reducing development time. However, even when importing 3D scans, it is not possible to render objects to scale using Minecraft blocks at quality resolution. Thus, significant refinement was often required for smaller artworks. 3D scanning was found to be particularly effective for immense artworks, such as Quinn's Love Bomb a 12-metre-high orchid see figure 4.

Figure 4. Love Bomb at Jupiter Artland and in Minecraft

Minecraft also has limited construction materials, with blocks made from a restricted geology and gemology (Sharp 2017). For example, Love Bomb, see figure 4, is constructed from steel covered with airline grade adhesive stickers, something impossible to replicate in Minecraft, yet a similar if non-texturally realistic alternative

of blocks of coloured wool offers an expressionist representation. Restricted resources were of concern for the virtual representation of Anya Galliaccio's The Light Pours Out of Me, that uses amethyst as one of its major materials. Amethyst is not available as a standard building block. However, applying Minecraft Expressionism, with its acceptance of substitution and approximation, we replaced the amethyst with modified blocks of Iron Ore, see figure 5.

Figure 5. The Light Pours Out of Me at Jupiter Artland and in Minecraft

Minecraft's potential to reveal the underlying strata of a construction had particular relevance for Andy Goldsworthy's Stone House. In the real and virtual parks on first view this appears to be a traditional stone cottage. In fact, the house surrounds an area of six metres by eight metres where Goldsworthy has excavated the ground to expose the underlying bedrock. This means that on entering the house one comes across an uneven floor, whether in the real or virtual Jupiter Artland made from the exposed land (or Minecraft blocks) itself.

Some Jupiter Artland works have more impact at certain times of the day or night. To enable children to engage with artworks at different times we have incorporated the passage of diurnal time. This is particularly effective for Nathan Coley's You Imagine What You Desire which is most effective in the dark, see figure 6. This installation also suffered from limited resources as it is constructed from scaffold poles and light bulbs, neither of which are available in Minecraft. This installation is represented through the use of Glowstone which has the property of lighting up in the dark creating a representation of the real-world experience.
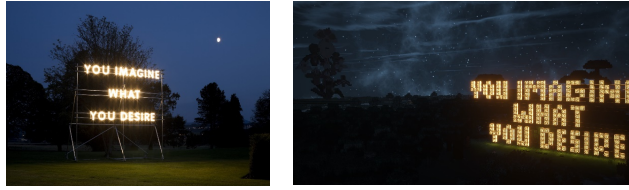
Figure 6. You Imagine What You Desire at Jupiter Artland and in Minecraft

Although our virtual Jupiter Artland was complete and we had successfully created Minecraft virtualisations of most of the artworks within Jupiter Artland, two works in the collection defied representation and we were unable to capture them successfully. One of these was Tania Kovats' Rivers a specially constructed boat house which contains specimens from 100 rivers across the British Isles. Building the boat house was a straight forward task. The specimens, however are stored in a collection of bottles. We were unable to represent these bottles in any convincing manner. We did initially use potion bottles, a standard Minecraft item but these were felt by the curator to be too far away from their real-world counterpart. Currently the boat house remains empty awaiting a solution. Another issue was Jim Lambie's A Forest which uses spray painted chrome, see figure 7. There is no effective way of producing an effect like this in Minecraft and although we provided a representation this completely lacked the vibrancy of the real artwork.

Figure 7. A Forest at Jupiter Artland and in Minecraft

Study 1: Children's Responses to virtual Jupiter Artland (V1)

Our work involves considerable collaboration and co-creation with children, based on cooperative inquiry seeking to actively involve children in the design process (Druin 2002). In developing virtual Jupiter Artland, we engaged with a class of 20 children, ten

boys and ten girls, all native Scots from a local primary school over three years. Here, we discuss their initial response to the first version of our virtual sculpture park. Further co-creation work with our class has included populating virtual Jupiter Artland and creating a mixed reality game (Flint et al. 2018).

We presented virtual Jupiter Artland to our class, with children in the role of informants (Druin 2002) providing feedback and suggestions about the virtual world. The children were familiar with and had visited Jupiter Artland, prior to engaging with our Minecraft version. Our goal was to gain their views on Jupiter Artland in Minecraft, and in particular, on works that had been created using Minecraft expressionism.

Jupiter Artland in Minecraft was installed on a local area network (LAN) with children accessing the virtual world utilising university laptops. Minecraft's build and mine interaction functions were disabled as we aimed to retain the integrity of the world for initial exploration and focus on what was already there, rather than what children may like to add and change.

Method

For this classroom-based activity, the children were seated at tables in groups of four and divided into pairs to interact with Jupiter Artland in Minecraft.

This session began with a discussion of Minecraft and the children's familiarity with it. The children were then asked to interact with Jupiter Artland in Minecraft sharing laptops in pairs for 2 hours. Minecraft asks users to declare their name and the children were asked to create a portmanteau name for their pairs. The children then entered the world at virtual Jupiter Artland's entry gates. Once the children had walked to the first artwork, Cells of Life, we turned on their ability to fly, providing them with their first aerial view.

The children's avatars were collocated in the Minecraft Jupiter Artland and children were aware of each other and could cooperate. We connected a laptop for the teacher to the classroom projector and this was displayed on the class whiteboard. This meant that all the children could see the teacher's view of avatars of the entire class sharing the same virtual world. This is demonstrated in figure 8.

Figure 8. Teacher's view as projected in the classroom (in front of Love Bomb)

The children were provided with paper maps, see figure 1. After the initial walk to Cells of Life, children were given 30 minutes of free range roaming to explore the Minecraft world. After this exploratory phase, children were then verbally asked to find works, such as Weeping Girls and Love Bomb, on the map and then flying their avatar to meet in that location.

While the children were engaged in navigating the virtual world we both observed the children and moved between groups with a recorder, asking children their opinions of our interpretation. Children were asked what they believed made Jupiter Artland special and if they felt we had captured this in our interpretation. We specifically asked them how they felt about our construction of the Weeping Girls and if there was anything they particularly liked or disliked about the Minecraft version.

Towards the end of the session, we enabled Minecraft functions that would allow children to build and mine within virtual Jupiter Artland. The session ended with a class-based discussion of the experience where we told the children that we wanted to

make a game that could be played simultaneously in Minecraft and the real Jupiter Artland and the views they had given would help us do this.

Results & Interpretation

The recordings, notes and observations from the classroom session were reviewed and aggregated, with a focus on identifying improvements for the artworks and the experience.

It is difficult in studies of this type to fully gauge whether the children are particularly enjoying the virtual world or whether the enjoyment is simply the novelty of having Minecraft in school. However, children did seem highly engaged with virtual Jupiter Artland, interested in how it had been created, visiting artworks they remembered and discussing the real and virtual experiences. The majority of comments were positive and any suggestions for improvement were constructive.

Using Minecraft for Virtual Jupiter Artland

With Minecraft's popularity in the age group, unsurprisingly, all the children had previously played Minecraft, some more than others. However, they had all played on tablet devices and were unfamiliar with laptop controls. With some brief support, children quickly gained understanding and familiarity with the controls and were able to readily engage in the virtual environment.

Some of the children discussed things they had built in Minecraft and where and when they had played with the software. It transpired that some of the children had attempted to replicate some of the artworks from Jupiter Artland in their own Minecraft worlds. The children were interested in what tools we had used and the amount of time it took to build.

Minecraft is predominately popular with boys and many of the boys were keen to demonstrate their knowledge of Minecraft. They did this by discussing Minecraft specific monsters such as The Wither and were vocal about wanting to use TNT, a popular activity in Minecraft is to create huge explosions by stacking TNT blocks atop one another.

Responses to Accurate Geography

Some children identified that accurate geography was a hindrance: one boy noted "*I think I would've made all the things closer together, you have to go on a really big trek to find them.*" When the researcher suggested that this was like the 'real world?' children highlighted that the problem was the duration, with boys identifying that it is "*not as much fun in Minecraft as it takes forever since Minecraft's much slower.*" Practical approaches to reduce the duration are provided by rapid Minecraft traversals such as flying, although children also suggested that the issue could be resolved by using a common artefact in Minecraft, built out of mine carts: for example, one boy stated "*I would make a rollercoaster to admire all the art.*"

Exploration and Experiences

The children were keen to explore their favourite sculptures and compare them to their real-life counterparts. During this engagement, children often renamed the artworks as they discussed them. Popular pieces included the Weeping Girls, often referred to as "*The Creepy Girls*" and Andy Goldsworthy's Coppice Room, with the children referring to this work as the "*Never-Ending House.*" The renaming often reflected the affective reaction intended by the artist highlighting that the artworks were provoking similar responses in their virtual representations.

Children enjoyed being able to get aerial views through the flying function, something they are obviously unable to do at Jupiter Artland. In particular, children enjoyed gaining an aerial view of the Cells of Life, with children finding this to be a strong and effective representation.

General agreement on works that could have been improved included Landscape with Tree and Gun. Our first attempt at producing this lacked finesse and we felt along with the children that it could be improved. Like ourselves, the children found Jim Lambie's A Forest of less impact in Minecraft, with the sparkle and reflection of spray painted chrome missing. They did however sympathise with the impossibility of trying to produce a mirror like reflective surface in Minecraft.

When asked how virtual Jupiter Artland could be improved, one boy responded "*If I would make it I would try to look at like really make it look like loads of people would want to come so they could see what I've created in my mind and everything.*" This, and other similar comments, highlighted that children understand and engage with the concept of creation beyond the real. This demonstrates an understanding that virtual Jupiter Artland provides as something created in the mind rather than in physical space. Most of the children, particularly those with considerable familiarity with Minecraft had no problems with navigating and moving around in Jupiter Artland in Minecraft. Some children were unaware of the fly command until told about it. Some children were challenged by navigating virtual Jupiter Artland, for example, one girl noted: "*Maybe some more signs so you wouldn't get quite as lost.*" Whilst she did have a paper map, this had not really worked for her.

The children were particularly keen to be able to interact freely with Jupiter Artland in Minecraft and wanted to build and mine within the world. Toward the end of the session we encouraged free play and turned on features such as fire and TNT. Many of the

boys took great pleasure in destroying parts of the world. A particularly popular activity

among the girls was to populate the interior of the private house, somewhere they

couldn't usually visit. Other activities included building tree houses and mining deep

underground.

The children particularly enjoyed gathering together in friend groups in virtual Jupiter

Artland. Though physically separate, they would meet and find each other within the

virtual space in order to cooperate on ambitious building challenges.

Fidelity

Some children felt that faithful representation with the real world was important,

identifying that in comparison the physical Jupiter Artland (with which all of the

children had familiarity) the Minecraft version was a radically alternative view, one girl

stated "*it's different everything's different.*"

Two girls discussed their reaction to the Weeping Girls, one told us that she would have

made it smaller. However, her partner stated that this would lose fidelity and resolution

saying, "*You couldn't get the hair*" meaning that a smaller version would not be able to

accurately represent the girls' hair. This shows an initial rejection of our version

followed by understanding of the issues and acceptance of compromise.

Whilst our focus had been fidelity with the real world, children also exhibited

expectation based on their Minecraft experiences, requiring a fidelity to the format as

well as the real space which it represented. One popular piece was The Light Pours Out

of Me which the children re-named The Crystal Cave, see figure 5. This sculpture is

visually reminiscent of a Minecraft mine and uses Obsidian as one of its materials,

something which is very common in Minecraft. A boy highlighted some similarities

between The Light Pours Out of Me and a Nether Portal, a Minecraft in-game

dimension portal. He felt that we should have exploited this similarity, building on a Minecraft reality rather than that of Jupiter Artland.

Improving Virtual Jupiter Artland

Using the results from the children, we revised and updated virtual Jupiter Artland. We improved the detail in many artworks, for example, Cornelia Parker's Landscape with Gun and Tree, was improved with detailed 3D modelling. Similarly, we enhanced our representation of Mark Quinn's Love Bomb providing our most visually realistic photogenic representation.

We had representational issues with Alec Finlay's A Variety of Cultures. This installation is an orchard of native plum and apple trees, these trees are young and planted adjacent to oak ladders. The ladders are placed in anticipation of the trees' growth providing access to fruit when they are fully mature. The trees are essential to the artwork, and our Minecraft representation now has the trees at full growth. This both provides a way to enable viewers to understand the elements of the artwork, but also offers an alternative temporal perspective, a view of the future of the art work.

We had also taken note of the children's view to make more of the opportunities in Minecraft to create experiences that could not be experienced in the real. For example, Hamilton Finlay's sculpture Temple of Apollo, see figure 9, is a relatively small sculpture and our original rendition of it was not particularly engaging nor liked suffering from a lack of finesse due to resolution. Creating the temple in full resolution makes it relatively enormous and it did not fit in with the geography around it.

In response, we provided two virtualisations of the same space. Thus, although our Minecraft facsimile upon first inspection appears to be a faithful but low-resolution copy of the original in the centre of the virtual temple is a hole that leads to a passage. The passage leads far underground into a cavern where a full-size representation is

presented. If this representation was to scale it would be the size of the Great Dome of St. Paul's Cathedral. This approach effectively mitigated one of the major issues with trying to create accurate renditions of sculptures in Minecraft, that of resolution.

Figure 9. Temple of Apollo at Jupiter Artland, in surface Minecraft and full resolution underground version.

New sculptures that had been installed since our initial version were created and incorporated into virtual Jupiter Artland. The geographical accuracy facilitated this process with rapid positioning and minimal build (beyond the sculpture itself) needed to modify the existing landscape.

Study 2: Virtual Jupiter Artland (V2)

Our work focuses on engaging children across the reality continuum, with our aim in this study to explore children's experiences of virtual and real Jupiter Artland, in particular evaluating virtual Jupiter Artland's efficacy as an affective remote experience of the works at Jupiter Artland. Three schools were recruited, two relatively local to Edinburgh and one in an island community in the North of Scotland. Children were aged between 9-11 years old, with 27 boys and 24 girls.

Of the two local schools, one visited Jupiter Artland in the real world and we subsequently visited them with a set of laptops on which we gave them a shared network experience of the Minecraft world on a local area network (LAN). The other school experienced the LAN followed by a visit to Jupiter Artland in the real world. The island community school only experienced the LAN.

Method

Each of the classes experienced a guided tour of Jupiter Artland. One school first toured the real version, whilst the other two had a similar tour in virtual Jupiter Artland. These tours were guided by one of the team from the Jupiter Artland Learning Foundation.

At a separate 2-hour session, children were provided with a paper map, a laminated diagram of the controls for accessing Jupiter Artland in Minecraft via laptops, and asked to explore and engage with the virtual Jupiter Artland. Children formed self-selected pairs and engaged in activities including free exploration and finding the teacher and/or artworks. During this, we observed the children and recorded their views of the virtual Jupiter Artland.

Results

The recordings and observations from the classroom session were reviewed and analysed using thematic analysis.

All of the children in our three classes were familiar with Minecraft and found virtual Jupiter Artland fun, engaging and a great experience. Comments were positive and children were impressed with the virtual world, recognizing that it had required significant effort. The children responded favourably towards all of the artworks they engaged with and/or that we discussed with them.

A child in our first study had suggested that Jupiter Artland is itself somewhat like a virtual world. With its oversized and extraordinary artworks in a curated bounded space, Jupiter Artland does indeed provide unusual, unexpected and as we were to find, some unbelievable artworks. For those children who had not yet visited Jupiter Artland, an issue that emerged was disbelief in the veracity of the artworks and doubts that they actually existed.

Unsurprisingly, the class that had already visited Jupiter Artland had no 'belief' issues, they could compare the virtual to the real. However, for children who visited virtual Jupiter first, there were considerable doubts, and indeed, some confusion on their visit to Jupiter Artland after their virtual experience.

In order to rapidly integrate sculptures into Minecraft, many of the artworks had been scanned, with the Minecraft representations of the majority of installations being geographically and dimensionally accurate. Whilst for some artworks, the resolution is relatively poor, as mentioned earlier our most visually realistic artwork is Quinn's' Love Bomb. The Minecraft version of this 12-metre high orchid is a faithful representation in terms of location and dimensions, with particular efforts made to realistically replicate colours and appearance.

Whilst children were happy with our Minecraft Expressionism, and raised no issues about artworks with limited visual realism, they were somewhat phased by Love Bomb. Children in the classes that experienced Jupiter Artland in Minecraft either before their visit or, as in the case of the island school on its own had doubts that Love Bomb existed in the real world.

To some degree this is an understandable reaction as few children will have experienced such enormous sculptures. However, it is odd that whilst children are prepared to accept almost everything else in viewing the piece first in Jupiter Artland in Minecraft, they often doubted that it actually existed in reality as part of the real Jupiter Artland. For Love Bomb, children rejected the reality provided by virtual Jupiter Artland, instead replacing it with their experiences of Minecraft – the provision of oversized structures to replicate smaller real artefacts. On visiting Jupiter Artland some children were astounded when they saw Love Bomb and discovered that the coupling between real

and virtual had been tight, and there really was a 12-metre high orchid at Jupiter Artland.

After engaging with Jupiter Artland in Minecraft, the class who were then going to the real park, were particularly interested in visiting Ian Hamilton Finlay's Temple of Apollo. As detailed above, we had extended this with children entering the low-resolution virtualisation and then accessing a high-quality resolution via a tunnel. This additional interaction was particularly enjoyed by the children and they were eager to experience it in the real world. However, as we and the teacher explained to the children this tunnel only existed in virtual Jupiter Artland.

On visiting the Temple of Apollo, this class were surprised and disappointed to find that the tunnel was not there. This is an odd and interesting result, the underground, enormous version of the temple would be an exceptionally difficult feat of engineering to produce and, yet the children chose to believe that it must be there. Considering their initial rejection of Love Bomb as a real artefact, it is interesting that they were ready to believe in the underground temple.

Discussion

The goals of the research reported in this paper had been 3-fold. Our first aim, to build a virtual facsimile of an extraordinary real-world environment that we can exploit for investigating the reality continuum was achieved. Jupiter Artland was successfully created in Minecraft, with the current version publicly available to download from Jupiter Artland's website. Our second aim was to explore the efficacy of a classroom based virtual experience as a substitute for, or introduction to, visiting Jupiter Artland. We recognize that we should never consider Minecraft as any kind of substitute for visiting the real Jupiter Artland. Instead, our goal is to produce an experience or set of experiences that will allow children to gain some sense of the experience of Jupiter

Artland if they are unable to visit. In this way, in part we can facilitate Jupiter Artland's mission of engaging with Every Child in Scotland. As an introduction to Jupiter Artland, our Minecraft world presents what is clearly an exciting space and encourages children to want to visit. Our final aim to create a modifiable platform to enable us to understand the constraints and opportunities of a virtual sculpture park as a means for facilitating exercises in contemporary art with children was achieved. In creating this platform for understanding the constraints and opportunities of building an environment of this kind, this project has particularly enabled us to examine the creation and use of low fidelity visual representations.

Minecraft is an effective and enjoyed environment for children. It is the most played of all games, with over 74 million active users in December 2017 (Horti 2018). All of the children in our studies had previously interacted with Minecraft and they all enjoyed the experience of virtual Jupiter Artland, engaging with innovative representations of contemporary sculpture and discussing their experience animatedly and positively.

In building the facsimile, our class of children provided valuable feedback on improving and refining the artworks of Jupiter Artland in Minecraft. Children, particularly boys, were aware of the time and effort that the virtual Jupiter Artland had required and were positive in response to our development efforts. This reflects the importance of time and effort in Minecraft construction with high value placed on structures that are difficult to build (Flint and Turner 2016).

Minecraft provides a useful world building tool to support relatively rapid, low-cost development that children will engage with, offering considerable potential for the cultural sector. In creating Minecraft spaces, it is critical to adopt what we have termed Minecraft Expressionism, an approach that allows one to celebrate and incorporate the

opportunities and affordances inherent within both the technology that is being used as a medium for representation and the environment being represented.

Using Minecraft Expressionism we aggregated and reduced the features of artworks, attempting to retain the most salient, meaningful and affective elements in the virtualised artworks, creating simplified and abstracted representations that engaged our child users. In general, our virtual artworks were relatively successful, not only in engaging the children but further in provoking children's emotional and personal responses and reactions. The majority of affective responses were positive, with children excited, engaged and interested in their explorations.

Several artworks resulted in specific affective responses, with children expressing empathy with the Weeping Girls, incredulity over Love Bomb and scared by the Coppice Room. As ultimately, the desired engagement with artworks is this individual reflection, affect and response, then to some degree our virtual representations are effective. However, although affective salience can be retained even where there is limited visual realism, this is less successful where artworks aim to elicit a less direct or more subtle affective response.

The geography, sculpture location and dimensions of Jupiter Artland in Minecraft typically exhibit high fidelity with the real park, with geographical accuracy of benefit in terms of sustainability and the ongoing curatorial programme. However, whilst accuracy enables sustainability and is effective for those curating or managing the space, the direct impact was that children found moving from one place to another slow and boring.

Minecraft is not slower than the real world, with walking traversal of 10000 meters at about 40 minutes, a fast pace for any individual. However, traversing the geography of Minecraft Jupiter Artland appears to be slower than reality. This perception of slowness

is partially due to children's expectations to be able to move quickly around virtual realities with teleportation commonly used. However, it is also likely that it is related to the uniformity of the Minecraft landscape. Jupiter Artland presents children with diverse flora and an ever changing landscape creating a unique immediate visual experience. In Minecraft where building materials are limited, such individual views and vistas are replaced by a somewhat generic landscape, with considerably less diversity. Although geographical accuracy could reduce engagement during long traversals of similar terrain, such challenges can be met using Minecraft affordances such as flying or teleportation taking advantage of virtual mechanisms to mitigate the reduction in realism and engagement.

When visiting Jupiter Artland in Minecraft, children are able to pretend that this visually unrealistic representation does have fidelity and veracity with a real park. They are able to apply their knowledge and expectations of a sculpture park, thus accepting the artworks and 'filling in the gaps' through pretence. However, in experiencing the virtual before the real, two artworks produced particularly interesting findings. Firstly, Quinn's Love Bomb, a visually realistic representation with accurate dimensions of a 12-metre orchid, whilst tightly coupled to the real was unbelievable to children who experienced virtual Jupiter Artland before visiting the park. Although throughout children were provided with a geographically realistic terrain and typically dimensionally accurate artworks, this predominant realism information was rejected in response to Love Bomb. Although this could be due to the unlikeliness of a 12-metre orchid, there were many other massive structures that children did believe in. With Love Bomb the most visually realistic artwork, it can be suggested that this tightly coupled representation prohibited believability in a mainly loosely coupled space. Whilst work on realistic aspects of virtual environments in the museum context has been undertaken

(Steier 2014), there has been limited consideration of what those aspects or features are for a large-scale, loosely coupled cultural experience targeting children with further work needed in this area.

Secondly, the children's expectation of a vast underground cavern at the Temple of Apollo was unanticipated. Clearly, such a vast underground cavern is beyond the estate of almost any sculpture park, yet the children were insistent that this was real. Thus, in contrast to Love Bomb, children now rejected their knowledge of reality, expecting a space that was highly unlikely. To some degree we can explain this desire as a reflection of childhood creativity and dreams of adventure, with tunnels to underground caverns featuring in many games, stories and films. Children's expectations of 'hidden' spaces highlight opportunities to incorporate enhanced, non-geographically accurate representations where a radically different experience could be provided than could be achieved in the real. This offers an opportunity for curating virtual artwork to complement the real collection in virtual space, with the potential to reconceptualise space through layering virtual experience (Jornet and Jahreie 2013).

Through using a loosely coupled visual realism and adopting Minecraft Expressionism in a geographically accurate space, Jupiter Artland in Minecraft provides a different perspective and representation of the sculptures than that experienced in real space. However, whilst the realism and authenticity is much reduced, children respond similarly to the artworks as they do in real space, with Minecraft representations generating personal and affective responses. Jupiter Artland in Minecraft is now used by the Educational Foundation in classroom and on-site activities, with the majority of children eagerly engaging with this alternative representation of Jupiter Artland, and staff using it as an approach to engaging children with contemporary art.

Through creating a Minecraft world, we have a portable and decoupled virtual version of Jupiter Artland that remote communities can access. Exploring the Minecraft environment in tandem with visits to the sculpture park in the real world provides an enjoyable experience for children. Having a Jupiter Artland in Minecraft should enable us to explore what appear to be the challenges and opportunities for a loosely coupled virtual reality. However, with the purchase of Minecraft by Microsoft, the underlying programming structure of the game is evolving towards device agnosticism. With such significant changes, to ensure the sustainability of our virtual world, we may need to create it within this new structure. Although this would be time consuming, it would have the benefit that our Jupiter Artland in Minecraft would be accessible on devices rather than laptops matching user expectations, with most children, including those in our project, using Minecraft on mobile devices.

Conclusion

We have successfully worked with children, curators and educationalists to develop an engaging and compelling virtual reality sculpture park. Through using Minecraft we have a portable and decoupled Jupiter Artland that remote communities can access. Jupiter Artland in Minecraft provides a different perspective and representation of the artworks, however, children frequently respond, react and engage the same across both the real and virtual representations, with similar affective impact achieved. In addition, our results have highlighted what appear to be 'glitches' in the reality continuum, where children erroneously reject knowledge and experience of the virtual in their expectations of the real and vice versa.

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