A Videogame for Architectural Design?
Minecraft for Young People to Imagine
Desirable Climate Futures

Bruno Andrade[1,3]([✉]) [ID], Saul Crowley[2] [ID], Chiara Cocco[2] [ID], and Brenda McNally[2] [ID]

[1] REMIT – Research on Economics, Management and Information Technologies, Portucalense University, Porto, Portugal
`brunoandrade@upt.pt`
[2] School of Architecture, Planning and Environmental Policy, University College Dublin, Dublin, Ireland
[3] Centre for Climate and Society, Dublin City University, Dublin, Ireland

Abstract. Cultural heritage has been under pressure from impacts of climate change, yet its conservation and rehabilitation seldom play a role in coastal sustainable development. Two-thirds of the world's population will live in cities until 2050, and more than one billion will live in coastal areas. New digitalization methods and tools have been applied in architectural, urban and landscape design to raise awareness of coastal communities about climate change adaptation and to protect their cultural heritage. Still, younger people have seldom been involved in the planning process, such as the review of master plans. Geogames, location-based games for public engagement, such as Minecraft, have been applied as an active educational tool for young people. Thus, how can Minecraft support youth engagement in co-designing climate adaptation scenarios for heritage-sensitive sites? We applied Minecraft as a geogame to engage 10–12 years old children to co-design climate adaptation scenarios for the Rogerstown Estuary area in North Dublin, Ireland. Parents also got involved, supporting their children's design process and reflections on climate change impacts and risks to their local/cultural heritage. Young people showed awareness of environmental issues and community needs. New questions emerged about using Minecraft and other geogames for capacity-building in wider consultation processes, as well as informing urban policy-making for greater conservation and sustainability of heritage-sensitive sites.

Keywords: Geogames · Co-Design · Youth Engagement · Climate Adaptation · Cultural Heritage

1 Introduction

Cultural, built and natural heritage has been under pressure from climate change [1, 2], yet its conservation and rehabilitation seldom plays a role in sustainable development [3, 4]. According to the World Urbanization Prospects published by the United Nations in 2018, two-thirds of the world's population will live in cities until 2050, and more

than one billion will live in coastal areas. Despite the urgency of such impacts, public policy and stakeholders' responses have yet to satisfactorily respond to this 'wicked problem'. Climate change is an adaptive challenge with practical, political and personal dimensions [5]. This requires systematic changes to climate action dependent upon a value system change.

Cultural values play an important part in value system change. They are the ones influencing the conservation of cultural heritage [6–8]. There is great risk for cultural heritage to be destroyed when the public is unaware of its significance or when it is unlisted, which is often the case of heritage only valued by citizens. Better informed architectural and urban rehabilitation can capitalize on the significance of cultural heritage to make coastal cities and communities more inclusive, resilient, safe, and sustainable. Hence, the main challenge concerning the relation of climate change with cultural heritage is whether and how, in particular, coastal communities will be able to conserve their cultural values in decades to come while facing climate threats.

New digitalization methods and tools have been applied in climate change adaptation planning for the co-design of conservation and sustainability scenarios. Digital and non-digital games got serious about climate change [9–11], acting as a form of interactive education, knowledge exchange and policy-making. Research being done in the last decade by online platforms such as "Games for Change"[1], "Games4Sustainability"[2], and "Climate Centre"[3] revealed that games are a fun and yet educational method for citizens to tackle complexities and uncertainties of the global and local climate. For instance, Minecraft, a block-building game, has been used in architectural, urban and landscape design all over the world. Block by Block, a joint initiative by Mojang, Microsoft and UN-Habitat has been successfully using Minecraft to redesign and rebuild public spaces in the Global South with the local community.

Though potentialities of these tools have been revealed as methods for active learning and engagement, the simplification of complex problems, decision-making and feedback exchange, systemic and scenario thinking, generative design, still younger people have seldom been involved in planning processes e.g., public consultation about the review of master plans, and assessment and monitoring of heritage under threats [12–15]. Younger generations are and will be key transformation actors in the development of a possible climate-proof future. Such involvement is crucial for awareness raising and capacity building of coastal communities to better equip them to face present and future adaptation scenarios.

This is why we applied Minecraft, a 3D block-building geogame, for young people to co-design climate adaptation scenarios [16–19]. Minecraft is categorised as a geogame when there is a 3D representation of a real socio-spatial context, and a design goal for public engagement [20, 21]. It allows players to 'mine' resources and use them to build a variety of 3D blocks following the brick-building logic of Lego. As a result, the game can reproduce real life building challenges by using geospatial data of the built and ecological environments. It fosters players' creativity to build structures such as buildings, public spaces as well as trees, animals, and rocks. In these cases, the game

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[1] Available at https://www.gamesforchange.org/games.

[2] Available at https://games4sustainability.org/.

[3] Available at https://www.climatecentre.org/priority_areas/innovation/climate-games/.

simulates a real socio-spatial context to allow players to visualize and make changes in a fun and easy way.

1.1 Theoretical Framework

The theoretical framework brings together the "Three Spheres Framework" [5, 22] (personal, political and practical), and the cultural significance framework (values and attributes) of cultural heritage [6]. The "Three Spheres Framework" underlines the correlated domains where transformations to sustainability may occur, referred to as practical, political and personal. These spheres represent objective and subjective aspects of transformation. Objective refers to technical aspects of knowledge. Subjective refers to individual and collective aspects related to beliefs, values, interests, and emotions.

Specifically, the subjective aspect of transformation will be assessed through the categories of values (social, economic, ecological, age, political, historic, scientific, and aesthetical) according to the framework of heritage values [23]. The objective dimension of transformation will be assessed through the categories of tangible attributes (e.g., built element, building, urban element, natural element) and intangible attributes (e.g., character, relation, use and knowledge) according to the framework of heritage attributes [24].

The level of transformation will be analysed according to the objective (attributes) and subjective (values) dimensions. This will point out to new perspectives about awareness raising and behavioral change related to the conservation and sustainability of heritage sensitive sites.

Only the personal sphere was considered due to the youth engagement process structure. Assumptions were made in other spheres due to the participation of parents and of local authorities. The levels of transformation were identified and discussed when comparing the future design scenarios with the current problems e.g., coastal erosion and flooding putting cultural and natural heritage under threat as well as coastal communities' ways of living.

2 Methodology

This research was part of the Coastal Communities Adapting Together (CCAT)[4] project which sought to explore the use of digital technologies to engage communities on the Irish Sea (Ireland and Wales) about climate adaptation. Our methodology adapted the US National Park Service (NPS) four-pillar approach to climate-change threats to cultural heritage: science, mitigation, adaptation, and communication [4]. Due to the potential of Minecraft as a visual research tool of inquiry, time and online engagement constraints, we focused on two of these aspects, adaptation (designs), and communication (images analysed). Ethical dilemmas were addressed and followed according to principles of justice, consent, and confidentiality. We got a full ethical approval by the University College Dublin's Research Ethics Committee.

We proposed a series of Minecraft online workshops between May and October of 2021 with young people ranging 10–12 years old, taking the Rogerstown Estuary

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[4] Available at https://www.ccatproject.eu/category/resources/.

area in Fingal, North Dublin, Ireland, as case study. Young people were recruited by Fingal County Council's Library team. They had a contact list for having already run Minecraft workshops before. They advertised it more widely to the local community using a "Minecraft Building Competition" slogan. In May there were 4 boys and 8 girls, 12 in total. In July there were 7 boys and 4 girls, 11 in total. In October there were 8 boys and 7 girls, 15 in total. Participants could choose one of the three towns, Rush, Donabate or Portrane. These workshops sought to include them in climate adaptation planning as part of a pilot consultation of Fingal County Council's local development review. Traditionally, this is an activity restricted to adults using conventional methods such as focus groups, questionnaires, and interviews.

Thus, how can Minecraft support youth engagement in co-designing climate adaptation scenarios for heritage sensitive sites? Particularly, we applied the "Geogames for Geodesign" methodology [25]. Such methodology brings together aspects from A) overlaying thematic layers of geographic information systems from Geodesign [26], and B) location-based games as a multi-player simulation for collaborative design from Geogames [20, 27, 28]. The model was built using FME (Feature Manipulation Engine), a geospatial extract, transformation and load (ETL) software, with geodata collected from Ordnance Survey Ireland.

A clear design goal was set for young people to design improvements in the estuary area for climate adaptation, which could encompass adding, removing and/or changing architectural structures such as buildings, coastal defenses, urban furniture, mobility, and greenery. Though it is a complex issue, the authors only gave general design options for the participants to follow their own ideas. This way their designs would reveal the current state of their knowledge and creativity.

Before the workshops, participants were asked to access learning resources about coastal climate change adaptation produced by the CCAT research team. Then, they were asked to complete an online questionnaire, and geolocation survey to foster their imagination for improving the local area. Finally, each online Minecraft workshop was structured and held sequentially over a strict time on a weekend:

1) Introduction session with explanation of the topic, design goal and workshop structure, 1-h duration.
2) Design session where each child worked remotely with the supervision of at least one guardian, 2-h duration, remotely.
3) Presentation session where children presented the visual representation of their design process accompanied by at least one guardian, 1-h duration.

Some of the 3D architectural designs were then selected as images for a research project aimed at understanding young people's visual representations of desirable climate actions and spatial changes [19]. The images provided insights on how Minecraft could also be used to shed light on young people's climate imaginaries. Imaginaires offer a way of understanding collective visions and therefore these images were also powerful indicators of young people's desirable climate futures. The study showed that young people's climate imaginaries offered an alternative vision to mainstream news and entertainment media preoccupation with dystopian constructions of the climate crisis. They also showed the power of Minecraft as a visual medium to open up new ways of seeing nature and envisioning nature-society relations. The images were analysed

using the theoretical framework to identify and reflect on the attributes and values (cultural significance), respectively, objective and subjective spheres of transformation. This helped assess the cultural significance which young people address to the new climate scenario. Understanding the cultural significance of heritage assets is crucial to review and/or develop more effective heritage policies that promote higher conservation and sustainability of these areas.

These images were also exhibited as part of the CLIMATE LOOK Lab 2022 held at the Open Eye Gallery, Liverpool. The gallery invited researchers, community groups and artists to use their space as a lab to engage visitors with reflections about the changing climate and to explore how different types of images can change the visual narrative on climate change.

3 Results

The first step was to analyse the online geolocation survey called "Map my Area", which was undertaken before the workshops on the Geodesignhub platform. The geo-survey focused on three assignments: 1) Design new bike path in Donabate, 2) Improve Rogerstown park, and 3) Improve Portrane's peninsula. Within these assignments, the young people were also encouraged to share what they liked about these places. Through a qualitative content analysis method, the data was clustered to identify and interpret patterns related to meanings, contexts, and intentions about the three assignments above mentioned.

Most proposals focused on the relation of greenery and the beachside, for instance, the path to connect Donabate and Portrane, the park and the beachside, e.g., "*It would be good if there was a path to the beach through here and if people in wheelchairs were able to get down to the beach and if there was somewhere for people to change for swimming and if there was a shower beside the beach*". There were mentions also to building a "*playground or play equipment on the green*" with "*charging points and WiFi*". Sports and active play was mentioned regarding "*football*", "*skip stones on the water*", and "*walks along the coast*". Young people's concerns centred on health aspects such as cleanness of the estuary and sea waters. Table 1 presents the results from the geo-survey and their respective existing or suggested design category.

There were also pre- (Table 2) and post-workshop (Table 3) questionnaires. However, the response rate was very low, only two participants overall responded. Tables 2 and 3 are, therefore, illustrative about reflections of children and their guardians/parents. This is not a generalization of the pool of participants.

The second step was to analyse the images (Minecraft screenshots), which were selected from the 3 online workshops held with 38 young people (10–12 years-old) in the Rogerstown Estuary area according to gathering a diverse range of climate adaptation designs. Participants proposed their designs to respond mostly to risks of coastal erosion and flooding due to climate change. They were also encouraged to propose improvements to at least one of the towns (Portrane, Rush and Donabate). First, we selected emblematic images on how young people are changing the visual narrative about climate change and climate futures. Then, we clustered these images by architectural design types: coastal defenses (see Fig. 1), new architecture and infrastructure (see Fig. 2), public spaces (see Fig. 3), and biodiversity (see Fig. 4).

Table 1. "Map my Area" online geo-survey results

Response	Category
"Telescopes with Bird information board- App information or the QR codes for bird sounds so people can scan, listen to the sounds, Small wooden walks hill walks or mazes or theme areas for kids like Slieve Gullion Forest Park".	✨ Your own idea
"Skate park on the top and picnic area"	🛹 Skatepark
"...telescopes, benches, outdoor exercise equipment and information boards and maps on the landscape and animals"	✨ Your own idea
"A cafe beside a playground so after you go to the playground you can buy something to eat or drink"	✨ Your own idea
"I'd put a seawater pool here, which would make it safe to swim in and any dirt and pollution would be filtered out"	✨ Your own idea
"I would put the pitch here because the solar/ panels could power the lights on the pitches"	⚽ Pitches
"A park to go on walks and to play ,put loads of trees in for the birds and animals. I think there should be an outdoor pool linked to the sea"	⚡ Wind mills and solar farm
"Bee hives & wildflower field & fruit trees"	✨ Your own idea
"Multi-sport court or/and café because it will create a good atmosphere"	✨ Your own idea
"I would put the pitch here because the solar/ panels could power the lights on the pitches"	⚽ Pitches
"A park to go on walks and to play ,put loads of trees in for the birds and animals. I think there should be an outdoor pool linked to the sea"	⚡ Wind mills and solar farm
"Multi-sport court or/and café because it will create a good atmosphere"	✨ Your own idea
"Enclosed dog play/ off lead area"	✨ Your own idea
"Because you don't have to walk too far from the car park to the playground"	🛝 Playground
"Because it would have a nice nature feel about it and possibly fish or pond dip"	🌊 Lakes/ponds
"I'd say a small pitch, something about the area and a few trees you can climb"	⚽ Pitches
"People will see it coming by so more people will visit"	🛹 Skatepark
"Bike trail"	🌳 Tree planting
"I would like to have an outdoor gym and obstacle course beside a playground"	✨ Your own idea
"I think there should be a wind mill and solar farm because there is a power generator right beside. (...) should be a tree planting area because there would be plenty of fresh air for the entire area. (...) should have a skatepark as it is a small area and skateparks don't need a whole field of space. (...) should be a playground as it is right beside the skatepark and tree planting area, it shouldn't be beside the windmills because it might be quite windy (on windy days it may be more windy because of the wind mill). (...) will be where I make my own design which will be a café beside a ice-cream stand".	✨ Your own idea

<div align="right">(continued)</div>

Table 1. (*continued*)

"...this would be great for the environment, and you could put a little mountain biking trail in between the trees connecting to the skatepark"	🌳 Tree planting
"...this would be good here because the street lamps could feed off the wind and solar electricity. You would also not have that many people going there because it used to be a gas generator"	⚡ Wind mills and solar farm
"...away from the main road and a bit of a walk from the entrance. the ramps I will build in Minecraft"	🛹 Skatepark
"I think there should be a playground here because its a big area and there is a skatepark right next to it"	🛝 Playground
"...this would make this area better because there is a lot of space for a few pitches for different sports"	⚽ Pitches
"The power generator would be a good place for the wind mills and solar farm"	⚡ Wind mills and solar farm
"With the landfill and generator here, its a good spot for the windmill"	⚡ Wind mills and solar farm
"An enclosed area for dogs off lead with a pond for them to splash in. families with dogs would use the park much more if their dog can get some running exercise too. You could also plant trees so that later in time you may be able to use a fully grown forest"	✨ Your own idea
"For younger kids this could be lots of fun because they might not be able for a very long walk"	🛝 Playground
"A hedge maze. This could be lots of fun for the family all year round but especially at Halloween. Native hedgerow plants could be used as a habitat"	✨ Your own idea
"A pump track, this is for bmx and mountain bikes, kids of all ages can practice biking without any extreme hills. there is no track like this in north county Dublin"	✨ Your own idea
"...cafe on a boardwalk, so you can see all the wildlife in the estuary, like birds on the wetlands and fish in the water, people walking won't damage the habitat. The cafe could be a pop-up coffee truck or a building"	✨ Your own idea
"I would like to put a few small lakes, some trees and maybe some picnic benches and a few swings or see-saws. It would provide entertainment for children and would be a nice place to have a picnic. There would also be lots of wildlife habitats and nature"	✨ Your own idea

The coastal defenses cluster revealed visual constructs of climate futures related to reimagining coastal defenses strategies solely to protect from sea level rise and erosion. Since this is a conceptual phase of the design process, it did not mean to dive into the complex adaptive system behaviors of such structures. Young people envisioned structures which serve both protective and infrastructural functions (see Fig. 1): a concrete wall that doubles as a passage/bridge, a green wall that also functions as a contemplative space, and a floating coastal viewpoint which monitors the sea level while also serving as a contemplative and socialization space.

Table 2. Pre-workshop questionnaire

Question	Response 1	Response 2
What do you know about environmental problems and the need to protect the environment	*Problem with environment is known for Years and it's evolving to some extraordinary level during the last couple of years. CO2 emission has been growing incredibly, amount of pollution globally especially in the 3rd world countries, where people don't really have enough awareness about environment had become a serious problem. There is a global need to reduce CO2 emission, take care about natural resources and create more awareness*	*I know about Climate Change and environmental problems because of things I have learnt in school eg. Fossil fuels, oil spills, farming, the dyeing of clothes, polluting of rivers especially ammonia. I watch David Attenborough documentaries. His last documentary was about how the planet has changed since he started work making documentaries. I know about recycling and biodegradable things. I am quite concerned about the environment*
Are there any actions you currently take to help protect your local environment? If yes, please tell us what actions you take or what actions your family take	*Currently we are segregating our bins, always switching off electricity when not needed, walking to the nearest store instead of using a car. Also always using reusable bags instead of buying plastic ones. Never leaving running tap during the cold weather (this actually became a serious problem locally) and cycle if possible. Also planning to get more into Hybrid/Electrical Vehicles (still a plan for my dad)* 😊	*I recycle things. I tell my parents to buy products that are recyclable and biodegradable. I know about Fair Trade and I lok for the sign on things in supermarkets. I pick up litter in the field/park near where I live*

(continued)

Table 2. (*continued*)

Question	Response 1	Response 2
How important is taking care of the environment to you	*This is something we must take extremely seriously if we want to care about our future generations. We are putting ourselves in extreme risk pollution, Extreme weather (which are a result of a CO2 Emission levels). Environmental awareness is something we are trying to engage regularly with our family. Trying to explain why we should all separate our rubbish or switch off electricity*	*Very, very, very important*
Do you take part in any activities (with your family or school) that involve taking care of the environment or talking about protecting it? Which ones?	*I'm a member of Scouts in Rush and we have regular programme for environmental awareness where I'm heavily involved. At school we have regular environmental awareness classes*	*We learn about climate change. We are raising money for people in India whose river is polluted with ammonia. We pick up litter in school*

The new buildings and infrastructure cluster revealed visual constructs of climate futures related to reimagining how to add new architecture for the use of the whole community. All designs below (see Fig. 2) encompassed public functions such as expanding the train station to better connect the towns to Dublin, new pathways for pedestrians and bikes, renewable energy (wind turbines), restoring old windmills, and an intriguing and innovative Café for both bees and humans. No buildings were demolished, green areas were kept, and new architecture added was mainly one-storey buildings in harmony relation with built heritage through form, materials, colors and textures.

The public spaces cluster revealed visual constructs of climate futures related to reimagining the use and appropriation of outdoor and open spaces. The images below (see Fig. 3) show that young people envision not a fearful future about climate impacts, but an outdoor life structured by design which can take advantage of the need to protect with the need to play (maze, aquatic play structures), learn (recycling plastic), contemplate (benches, pathways) and socialize (community picnic area). This changes the aesthetic from fear (of sea level rise to damage and destroy buildings) to the possibility of enjoyment in the waterfront. The focus on food-sharing and creating spaces for food-sharing in this area exemplifies visually a counter-narrative to mainstream consumerist relation to food.

Table 3. Post-workshop questionnaire

Question	Response 1	Response 2
How often do you think about environmental problems as you go about your day?	*"Actually on a daily basis. Always trying to have in mind some things which can help to improve our environment"*	*"Very often"*
Has the Minecraft workshop increased your understanding of the need to protect your local environment and help stop climate change? If yes, tell us about what you have learnt	*"I've learnt about good planning and need for some facilities for people which will lead to make our environment better (more bins, more places where we can exercise) but also create more awareness"*	*"Yes, I learnt that there are park designers. I learnt that it is important to make family nature reserves so we can realise what is happening to the environment and how to stop it"*
Has the Minecraft workshop inspired you to do more to protect the local environment and stop climate change? If yes, can you tell us more about what it has inspired you to do	*"Definitely inspired me to be more aware and creative but also talk to the others about this so there is a chance that by spreading proper message – more people became more environmentally aware just like myself"*	*"Yes, because I learnt about parks. It has inspired me to buy less plastic and to recycle more"*
Do you think this game experience will lead to you working/connecting with others to tackle climate change issues or raise awareness of these issues? If yes, please explain why and in what ways you think you might work with others? If no, can you tell us why not	*"As mentioned it actually made me more to spread more awareness between my friends to speak about environment and climate change and think more about what we are doing in our day to day life for to tackle climate change with success"*	*"No, not really. I think playing the game more often would help and also talking about it. Suggest to show people the controls. Do the project over more than 2 days"*

The biodiversity cluster revealed visual constructs of climate futures that attempt to imagine human-nature relations by focussing on co-existence, such as bird watching, beehives, vegetable garden, wildflowers, farm animals. The designs below (see Fig. 4) show the co-existence possibilities of human and non-human as resources for a climate future. This is an attempt to associate heritage restoration, preservation and development. Such planning and management direction of heritage sensitive sites has been most appreciated and defended in the heritage field in the last decades [3, 29].

The results revealed that the young people involved understood better the educational purpose of the game mission, including their parents. By anecdotal evidence, parents shared in the final presentations they supported their children's design process and reflections over climate change adaptation and the risk to their cultural heritage, without interfering in their choices. Interestingly, one representative of Fingal County
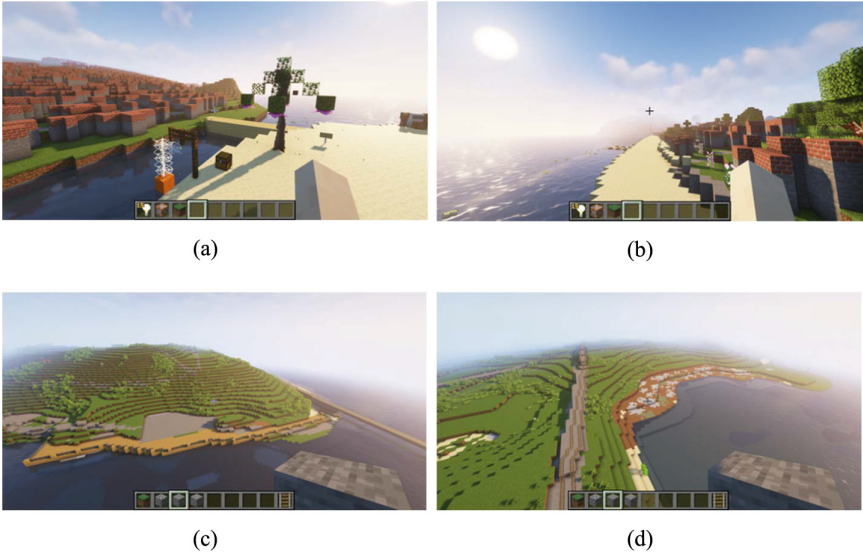
(a)

(b)

(c)

(d)

Fig. 1. Coastal defenses

(a)

(b)

(c)

(d)

Fig. 2. New buildings and infrastructure

Council (FCC), present in the final online session of the first workshop in May 2021, shared there were similarities between young people's design ideas and FCC's master plan review e.g., renewable energy; grey, blue, and green infrastructure; biodiversity
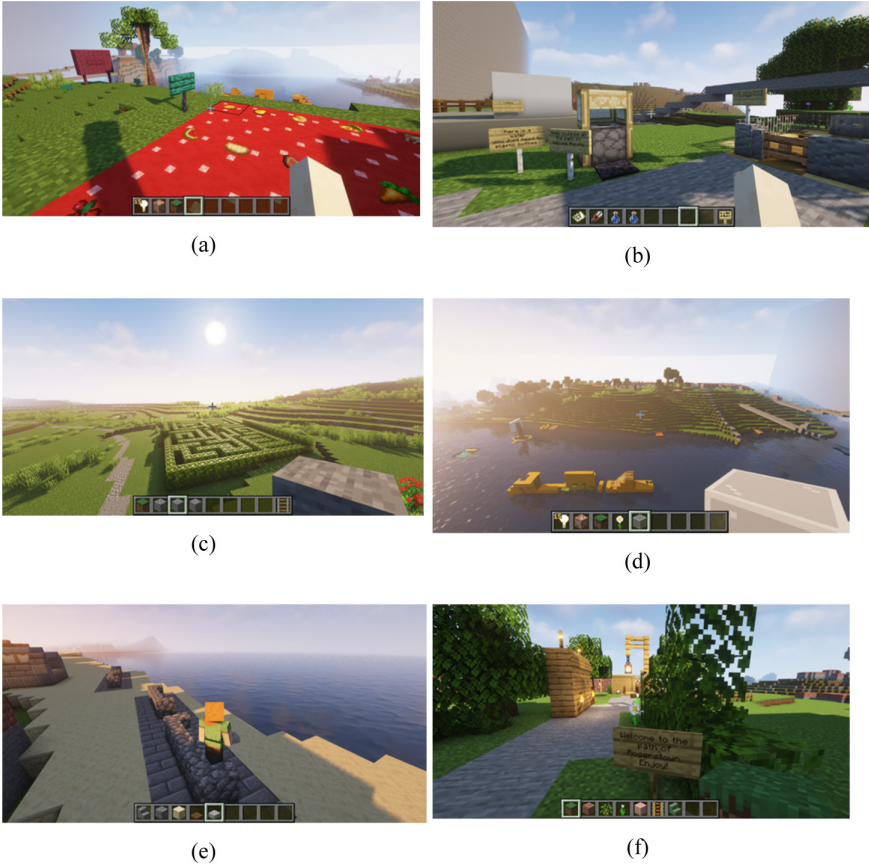
(a)

(b)

(c)

(d)

(e)

(f)

Fig. 3. Public spaces.

parks; recreation areas; and coastal defenses. This was evidence to FCC of the value of engaging young people in town planning consultation processes.

While there was a balance in the number of boys (18) and girls (20) participating overall, it was noted that boys designs were more active whereas girls produced more contemplative designs. Both boys and girls included similar environmental solutions: focussing on green areas, and prioritising biodiversity and wildlife through design solutions involving reforestation, bird watching, bees and beehives.

Most designs had signs which revealed the proposed function or acted as orientation for the use of the space, such as "Bird watching: keep quiet", "Bee town", "Bee Café for pollen", "Toss a coin, make a wish!", "In case of lost children, please call the number 5551743", "Welcome to the path of Rogerstown, enjoy!", "Here is water, you don't need plastic bottles", "Over here there be a playground". This showed how young people value a clear design with information about how to use such spaces. Designs showed that only a few participants focused only on recreation designs, whilst most of them showed climate
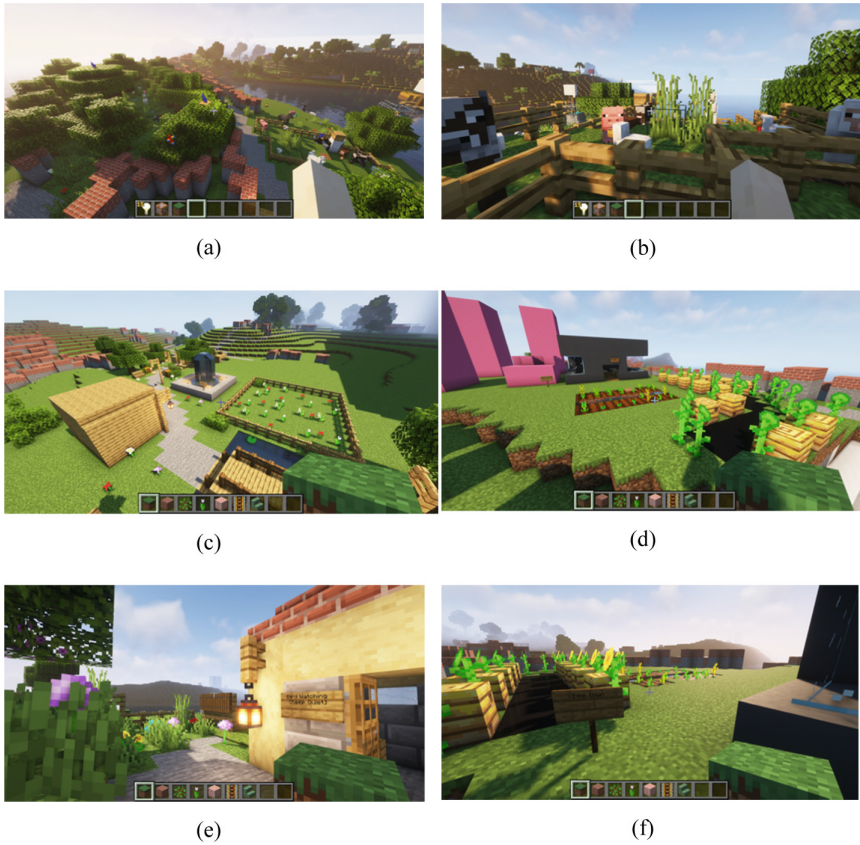
(a)

(b)

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(d)

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(f)

Fig. 4. Biodiversity

adaptation awareness and tried to propose solutions related to coastal defenses, greenery and biodiversity, and renewable energy.

Potential barriers revealed by this study on youth engagement with Minecraft may be related to 1) access and resources, 2) technical skills, 3) time and commitment, 4) safety and privacy, and 5) feedback integration. Not all young people may have access to the technology to play the game. It can be challenging for them to learn how to use the game on a desktop computer (instead of mobile phones and videogame console) to better understand and propose solutions to issues related to urban planning processes. Though it is not time-consuming it is hard to engage young people in Minecraft workshops apart from partnering with schools and libraries to include in their present curricular or extra-curricular activities. Ensuring their online safety and privacy adds another layer of difficulty, since the presence of a guardian is required to monitor their interactions with other players. Lastly, gathering feedback about the design process can be difficult, because to take place in-game adds more complexity and can break the flow.

Potential strengths revealed by this study were 1) digital literacy, 2) environmental and heritage engagement and motivation, 3) creativity and collaboration, 4) visualization

and immersion, and 5) youth empowerment. Young people can develop and enhance digital literacy skills by using Minecraft to materialize their design ideas. The game is popular among young people and can attract and hold their attention in a diverse range of activities. It is a creative, friendly and immersive platform for visualizing and designing architectural and urban spaces, in which young people can bring imaginative and innovative solutions and test the impact of their choices in a real-world context. The game allows for collaborative design, enabling young people to work together, and learn to negotiate and reach consensus about heritage-sensitive sites. Hence, the process can empower young people to foster a sense of ownership in the future of their cities and communities, creating a culture of participation. Lastly, the outcomes of such a process can inform local authorities about the needs and values of the youths, who have an unique perspective and positioning about architectural, urban and landscape issues.

4 Conclusion

The Minecraft workshops were a valuable opportunity to include young people's visions on climate adaptation as part of a local development consultation (a process which is traditionally restricted to adults). We explored Minecraft as a participatory visual method of inquiry to simulate climate adaptation design with/for young people. Strengths of the game encompassed active learning through playing, socialization and engagement, comprehension of complex problems via scenario thinking, and knowledge exchange and peer-review. Limitations were mainly technical about learning to play Minecraft on a computer, acquiring a license, and joining the online session. Another one related to the abstract aesthetics of the block-logic representations, which did not allow detailing less than 1 m^3.

The Minecraft geogame tool, with colored bulky blocks and cumbersome pixels, enabled young people to express their climate agency, the subsequent, and unexpected interest of parents in the exercise fostered intergenerational conversations about climate change adaptation in the local area. This online youth engagement process was also used as a space to provide recommendations for 1) local authorities on the uses of Minecraft as a co-creation design tool for the review of master plans through the lenses of climate adaptation, and 2) educational institutions on the extracurricular learning opportunities of Minecraft as an awareness raising tool for alternative and counter-narrative climate futures and cultural heritage conservation and sustainability.

Both recommendations call for strengthened policy integration and change in Irish and other coastal and water-front areas over climate change adaptation and public participation. Moreover, actively involving young people in decision-making and policy implementation is key to realize the benefits of their contributions. New questions emerged about how to up-scale, capitalize and give feedback to young people about their inputs. Also, which is the best option to include Minecraft as an educational and capacity-building tool for schools and libraries, in present curricular or extracurricular activities. Further research is needed to investigate Minecraft as a gaming-simulation resource to raise awareness about intergenerational exchange, assessing behavioral issues, as well as quickly responding to emergencies and problematic climate change scenarios impacting heritage-sensitive sites and communities.

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