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Gamifying Flood Resilience: Serious Games, Playful Placemaking and Blue Green Infrastructure Planning

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Gamifying Flood Resilience Planning: Participatory Placemaking and Blue Green Design

Abstract

Flooding in the UK is expected to become more frequent because of climate change, creating an urgent need for adaptation. In Scotland, national policy promotes placemaking approaches that integrate blue green infrastructure (BGI) into urban areas to enhance climate resilience and deliver social, environmental and economic benefits. Community engagement is central to this process, yet top-down planning approaches often limit participation. Despite recognition of the value of collaborative approaches, guidance on implementation remains limited. The significance of this study lies in addressing this gap in participatory, place-based climate adaptation planning.

The aim of this paper is to investigate how human-centred, playful participatory methods, specifically serious games and LEGO® Serious Play®, can facilitate inclusive, place-based adaptation planning. This aim is addressed through a qualitative analysis of three participatory workshops in Dundee and Broughty Ferry, Scotland, involving residents, students and practitioners. Using these methods within a placemaking framework, participants co-designed locally grounded solutions. Workshop outputs were analysed using Template Analysis to examine adaptation solutions, flood-mitigation functions and wider co-benefits. Findings show the approach surfaced flood-risk concerns alongside priorities including biodiversity, public amenity and wellbeing. The originality of this paper lies in demonstrating how playful, human-centred methods support inclusive, context-sensitive climate adaptation planning.

Keywords

Blue Green Infrastructure; Community Participation; Placemaking; Serious Games; Serious Play; Sustainability; Climate Adaptation; Town and City Planning; Urban Design; Gamify; Flooding

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1. Introduction

Flooding in the United Kingdom (UK) is expected increase because of climate change (Rudd, Kay *et al.*, 2019). Flooding brings significant challenges, such as detrimental impacts on health and financial loss (Twiddy, Trump *et al.*, 2022). This brings an urgent need to adapt to the impacts of climate change. In Scotland, the National Planning Policy Framework 4 (NPF4) and the Water Resilient Places Policy Framework, emphasise the importance of blue and green infrastructure (BGI) in enhancing resilience to flooding and creating sustainable, resilient communities. BGI involves integrating natural water flows and green spaces into urban environments (Lamond and Everett, 2019; Sörensen, Persson *et al.*, 2021). For instance, through green walls, green roofs, permeable pavements or rain gardens.

A placemaking approach is highlighted in the Water Resilient Places Policy Framework as fundamental to blue green, water resilient places in Scotland (Scottish Government, 2021). Although it evades a singular definition, placemaking is broadly understood as the process of creating or reshaping public spaces to foster health, wellbeing, environmental and economic benefits (Akbar and Edelenbos, 2021; Keidar, Fox *et al.*, 2024; Wyckoff, 2015; te Lintelo, Ip *et al.*, 2024). Community engagement is a critical component of placemaking, ensuring long-term benefits and cultivating a sense of ownership over the process (Ellery & Ellery, 2019). However, an independent review of community engagement in Scottish planning found that jargon, online portals and technical language restricted “participation in planning rather than actively promoting it” (Yellow Book, 2017). This reflects wider concerns that urban design and planning utilise a top-down approach which planners are treated as the primary experts, responsible for developing proposals that are then passed to decision-makers for approval or rejection (Semeraro, Nicola *et al.*, 2020).

Within climate adaptation planning, top-down methods, or approaches that fail to meaningfully integrate local knowledge and context may result in adaptation which overlooks the unique characteristics of a location (Olazabal, Amorim-Maia *et al.*, 2024). The limitations of top-down community engagement present a need to integrate local knowledge through inclusive, collaborative, bottom-up approaches (Olazabal *et al.*, 2024; Al Waer, Rintoul *et al.*, 2021). Despite recognition of

the value of this, there is no clear guidance on how this can be achieved within adaptation planning (Everett, Adekola *et al.*, 2021; Griffin, Revill *et al.*, 2024).

The need for more inclusive, locally led approaches to climate adaptation is not unique to Scotland. Internationally, policymakers increasingly highlight the need for locally led, participatory approaches to climate adaptation, yet practical methods to achieve meaningful engagement remain limited (Parsons, Godden *et al.*, 2025). This is especially relevant in the context of international policy frameworks such as the United Nations Framework Convention on Climate Change and the Sendai Framework for Disaster Risk Reduction, both of which emphasise the centrality of community engagement in climate adaptation and disaster resilience planning (United Nations, 2015; United Nations Framework Convention on Climate Change, 2024). It also aligns with the United Nations Sustainable Development Goals, particularly Goal 11 (Sustainable Cities and Communities), Goal 13 (Climate Action) and Goal 16 (Peace, Justice and Strong Institutions), which highlight the importance of inclusive, participatory and resilient approaches to urban development and climate adaptation (United Nations, nd). Thus, developing understanding in this area is essential to ensure adaptation is tailored to community need while increasing resilience to extreme weather events.

This study makes an original contribution by demonstrating how human-centred, playful approaches can facilitate inclusive, place-based climate adaptation planning. It provides a critical analysis of participatory workshops which combined a serious games and LEGO® Serious Play® (LSP®) approach, underpinned with a placemaking philosophy, to facilitate participation in BGI planning. Meaningful engagement in community-based planning requires the use of facilitation tools and techniques that enable participants to express tacit knowledge, explore ideas creatively, and feel confident contributing to shared decision-making. Research on participatory placemaking reinforces this by highlighting the value of bespoke, hands-on methods for creating inclusive, constructive dialogue (Alwaer and Cooper, 2019).

Utilising serious games, serious play and creative approaches to engage communities in climate action has grown in interest in recent years (Sillanpää, Eichhorn *et al.*, 2024; Neset, Andersson *et al.*, 2020; Burke, Ockwell *et al.*, 2018). However, these remain an under researched areas (Razali, Ramli

et al., 2022; Burke *et al.*, 2018). In response to the identified knowledge gaps, the aim of this research is to investigate how human-centred, playful participatory methods, specifically serious games and LSP® can facilitate inclusive, place-based climate adaptation planning. To achieve this, the paper pursues three objectives. It will analyse the adaptation solutions generated in the workshops, how they reduce the risk of flooding and their relationship to current literature on BGI. It will also analyse how placemaking principles and the use of LSP® and serious games facilitate meaningful, inclusive community participation in developing BGI solutions. This research will be of value to academics, policy makers and practitioners with a remit in climate adaptation planning, community engagement, urban planning and flood risk management.

2. The study area

The participatory workshops were conducted in Dundee and Broughty Ferry, Scotland, figure 1. Figure 2 shows an overview of the study locations in Scotland. Both locations sit within the Dundee Local Authority area and experience surface water, coastal flooding and flooding from the Dighty Burn, which runs through the city. Dundee City Council and Scottish Water acknowledge the urgency of developing innovative ways to manage flooding across the city (Scottish Government, 2025). This includes BGI that supports social, environmental, economic and wellbeing benefits (Dundee City Council, nd; Dundee City Council, 2021). Delivering BGI that brings wider benefits is particularly pressing in Dundee. The area is one of the most deprived in Scotland, with 70 out of 188 data zones falling within the 20% most deprived (Dundee City Council, 2022). Broughty Ferry and Broughty Ferry Central also experience socio-economic inequalities. For instance, every community area within The Ferry Ward has a proportion of residents classified as income deprived (Dundee Partnership, 2020). These two locations represent contrasting but related flood-risk contexts within the same local authority, allowing exploration of how community experiences and local conditions shape priorities for BGI. Their differing socio-spatial characteristics and flooding types offer a useful basis for understanding place-specific perspectives within a coherent study area.

Figure 1: Map of the Dundee and Broughty Ferry area. Map data © OpenStreetMap contributors, licensed under the Open Database License (ODbL) (<https://www.openstreetmap.org/copyright>).

Figure 2. Overview of the study locations in Scotland. Map data © OpenStreetMap contributors, licensed under the Open Database License (ODbL) (<https://www.openstreetmap.org/copyright>).

3. Conceptual Foundations: Placemaking, serious games and serious play

Placemaking in urban planning is widely described as a collaborative, process that shapes and transforms public spaces, integrating community experience with design and management (Istoriou and Pozoukidou, 2025). Placemaking has been shown to involve active community participation, with residents and stakeholders contributing to decision-making processes to ensure public space better reflects their needs (Ellery and Ellery, 2019). Placemaking draws on concepts such as place attachment and sense of place to stimulate a collective reimagining of a place (Barry and Agyeman, 2020). That is, drawing on the emotional and psychological bonds that connect people to their environments to ensure that this informs the development of a place. Placemaking also emphasises the importance of community engagement in the co-design of public space (Keidar *et al.*, 2024; Crowe, Dawson *et al.*, 2025). This approach holds promise in engaging communities in BGI planning as it frames adaptation around community values and local concerns (Kythreotis, Mantyka-Pringle *et al.*, 2019). Evidence suggests that socio-cultural outcomes of BGI are shaped by how communities perceive and use spaces, highlighting the importance of participatory and co-design approaches aligned with local values and context (McNabb, Charters *et al.*, 2024). Moreover, engaging communities and identifying beneficiaries can strengthen support for BGI and help realise its multifunctional benefits (O'Donnell, Lamond *et al.*, 2017)

The importance of communities in BGI planning is acknowledged within the NPF4 and the Water Resilient Places Policy Framework. However, top-down approaches can hinder rather than enable community participation in planning (Parsons *et al.*, 2025; Siddiqui and Ishtiaque, 2025). Similarly, Lew (2017) argues that placemaking is frequently guided by top-down processes. This results in adaptation that overlooks the characteristics of a place and leads to resistance to interventions (Simon, Diprose *et al.*, 2020). There is increasing recognition of the need for equity-centred and participatory approaches to urban resilience planning, where communities are actively involved in

shaping priorities and outcomes (Fitzgibbons and Mitchell, 2021). Creative approaches are increasingly acknowledged as a tool to achieve this objective. In this context, serious games and serious play have emerged as promising tools to stimulate meaningful participation (Sillanpää *et al.*, 2024; Neset *et al.*, 2020).

Serious games are designed for reasons beyond entertainment (Andrew, Barwood *et al.*, 2023). They include digital applications, board games and the use of gaming elements (The University of Warwick, 2024; Aubert, Bauer *et al.*, 2018). This can include a scenario and challenge, an opportunity to collaborate with others and a debriefing session (Aubert *et al.*, 2018). Serious games can facilitate awareness raising, research, inclusive dialogue and a shared understanding of complex issues (Rodela and Speelman, 2023). Furthermore, Flood *et al.* (2018) point out that serious games hold significant potential to stimulate action in climate adaptation planning. However, serious games are not widely utilised to foster engagement in this regard (Hügel and Davies, 2022).

Play is broadly understood as something that is self-chosen and self-directed, carried out for enjoyment, imaginative and creative (Gray, 2017). Play is also related to innovative thinking, meaning it can generate new approaches and ideas by adopting a more playful outlook (Lodwick, 2023; Proyer, Tandler *et al.*, 2019). To this end, the LEGO® Group, created the LSP® methodology. LSP® is a facilitated workshop where participants use LEGO® bricks to build metaphorical models in response to a given task (Dempsey, Riedel *et al.*, 2014). LSP® was originally developed to support innovation, strategy development and performance improvement within business environments (Ferreira, Robertson *et al.*, 2024). The idea underpinning LSP® is that it allows all participants to have a voice in the workshop proceedings and permits participants to understand the ideas of others (Fearne, 2020).

Over time, the LSP® method has been adapted beyond its managerial origins, demonstrating its flexibility across diverse sectors. For instance, Shipway and Henderson (2024) used LSP® in mental health research to explore the challenges experienced by children in school settings. Tewdwr-Jones and Wilson (2022) employed LSP® to generate ideas for new urban projects. This included a delivery framework to promote social enterprise and economic development and a platform aimed at

supporting inclusive growth and equitable societal infrastructure to advance a circular economy. These examples illustrate the method's adaptability and its capacity to support participatory idea generation in complex contexts. However, while these studies demonstrate its potential for engaging with complex issues, its use within climate adaptation or BGI planning remains notably underexplored in the academic literature.

4. Methodology

The following section outlines the research design, the workshop methodology, participant recruitment and composition. It also explains the approach to data analysis used to capture and interpret community-generated insights.

4.1 Research design

This research is situated within a qualitative research design, underpinned by a pragmatic stance. A qualitative approach is often used when a phenomenon is underexplored and requires an open-ended, exploratory investigation (Creswell, 2009). Pragmatism is focused on tackling real-world problems through practical approaches, methodological flexibility and plurality of methods (Kaushik and Walsh, 2019). Therefore, it supports the utilisation of creative, participatory methods to generate meaningful insights into BGI planning. Importantly, this alignment between philosophy and real-world practice strengthens the ability of the research to inform theory, policy and practical considerations in climate adaptation planning.

4.2 Workshop approach and adaptation of LSP®

The workshops deviated from LSP® in two ways. Firstly, LEGO® was not used in a metaphorical way to represent abstract concepts. Instead, participants were instructed to use LEGO® to literally represent their environment. This approach responded to shortcomings identified in the scholarly literature. For instance, Benesova (2023) undertook an LSP® workshop with higher education students. In this study, some students conveyed a lack of confidence in using LEGO® to create metaphorical models. Furthermore, Taylor and Dewsbury (2018) notes that metaphors can fail to

illuminate critical dimensions of a topic and may transfer the meaning of the metaphor onto the discussion at hand. The second difference is that other items, such as stickers, pens, felt sheets, card and modelling clay were provided in addition to LEGO®. These items were included to overcome limitations identified in the literature. For example, limitations related to the variety and sizes of LEGO® bricks and the orthogonal nature of Lego® making it challenging to represent organic features (Boa, 2017; Mathias, Snider *et al.*, 2019). Moreover, Horn (2025) and Isa and Liem (2023) found that when combined with LEGO®, objects such as clay and card facilitated a greater shared understanding and expression of conceptual thinking. These adaptations to the LSP® methodology were made to increase confidence in the model-building task, remove barriers to interpretation and understanding of the models and make it simpler to represent organic features within BGI. Figure 3 provides a concise overview of the approach to the workshops.

Figure 3: Approach to the workshops: Combining serious games and serious play with a placemaking philosophy

4.3 Participant recruitment

The workshops were aimed at all adults over 18 interested in making Dundee and Broughty Ferry more resilient to flooding in ways that brought wider benefits. Participants did not need prior expertise to take part in the workshop. An open call approach was used to avoid restricting or pre-defining who might be considered a relevant stakeholder. This is consistent with qualitative research principles, which emphasise recruitment of participants to capture a diversity of perspectives and experiences relevant to the research question, rather than aiming for generalisability (Bazen, Barg *et al.*, 2021). In practice, participants who came forward included community members, practitioners and students. These groups represent different and complementary positions in relation to flood resilience. Community members contribute local knowledge and lived experience and practitioners bring professional and institutional perspectives. Students can bring a transitional and mobile perspective shaped by temporary residence and evolving place attachment (Kramer, Pfaffenbach *et al.*, 2025). This range of participants ensured coverage of stakeholders and perspectives relevant to the studies aim.

As participants had to be over 18 years old, the sampling strategy aligns with the purposeful sampling method. It also shares commonalities with voluntary response sampling, in that people self-selected to take part. This may have introduced self-selection bias, attracting participants particularly interested in flood resilient planning. Self-selection bias is a well-recognised limitation of non-probability sampling in qualitative research (Hiratsuka, 2025). Nevertheless, the diversity of participants who self-selected, as discussed below, enabled the study to capture a broad range of experiential, professional and place-based perspectives relevant to the research aim.

The workshops were widely promoted on social media and through a range of relevant community groups working within the research areas. The University of Dundee also shared details about the workshop within its weekly student bulletin. Emails were also sent to community groups to ask them to promote the event through their own channels. The first workshop in the Maxwell Centre, Dundee, attracted five participants. Three further people signed up but did not attend the event. All participants were community members apart from one who was a community engagement and sustainability practitioner. The second workshop, in St Aiden's Church, Broughty Ferry, attracted nine participants. Participants comprised of community members, with one attendee who did not live in the area, attending with a family member who did. Four people initially signed up to a third workshop, at the University of Dundee. However, due to adverse weather conditions, two cancelled. The two attendees were students at the university who lived in the locality.

While attendance varied across the workshops, the total number of participants across the three sessions aligns with recommended sample sizes for qualitative research in relatively homogenous groups (Rahimi and Khatooni, 2024; Hennink and Kaiser, 2022). Furthermore, practical guidance from practice-based sources suggest that, for small group workshops, between three and ten participants allows time for detailed individual contributions (Gov.uk, 2018; Co-production Network for Wales, 2023). Beyond numerical considerations, the sufficiency of the sample is demonstrated through the depth, specificity and diversity of the data generated. The aim of the study was not to achieve representativeness, but to investigate how human-centred, playful participatory methods can facilitate inclusive, place-based climate adaptation planning. The combination of community members,

practitioners and students produced complementary forms of local, experiential and professional knowledge. This resulted in rich, context-specific insights into flooding, everyday place use and priorities for blue-green infrastructure. As evidenced in Sections 5.1–5.5, participants articulated detailed reasoning about flood mitigation, biodiversity, amenity and wellbeing. This demonstrates that the dataset contained rich and specific insights. The LEGO®-based approach further enabled the expression of tacit, spatial and affective knowledge that may not emerge through conventional engagement methods. Taken together, these factors demonstrate that the sample was sufficient to address the research aim and to generate meaningful insights into how playful, human-centred methods support inclusive climate adaptation planning.

4.4 Conducting the workshops

The intention was for participants to work in small groups to build the models. However, this was not always the most viable or preferred option for participants. Therefore, participants at the Maxwell Centre workshop worked as a collective team to build one model. In Broughty Ferry, models were built by two individuals as well as by a group of three and a group of two. This approach allowed each participant to work in a way that suited them best. It also aligns with the principles of participatory research which advocate for research processes that are responsive to participants' needs and priorities (Lloyd-Evans, 2023). Additionally, it helped to demonstrate how effective the model building task was when using different approaches. This flexibility did not compromise analytical robustness, as the study did not aim for direct cross-workshop comparison. Furthermore, all outputs were analysed using a single, consistent TA coding framework across the dataset, with the methodological rationale outlined in Section 4.5. Table 1 provides an overview of participant details and a code that identifies the model they built.

Table 1: Workshop participant details.

Location and date	Participant/group identity code	Participant background
The Maxwell Centre, Dundee. June 2024	MC	4 x Community members. 1 x Practitioner (climate and community engagement)

The University of Dundee. November 2024	DU1	1 x Student and community member.
	DU2	1 x Student and community member.
St Aiden's Church Broughty Ferry. October 2024	BF1	1 x Climate and environmental interest and community member.
	BF2	1 x University lecturer and community member.
	BF3	2 x Public greenspace interest and community member.
	BF4	1 x University lecturer, 1 x water management professional, 1 x community group member. All were community members.
	BF5	1 community member and relative.

The majority of participants had limited prior technical knowledge, allowing workshops to focus on experiential and place-based input. To establish the context in relation to place-based issues, participants were asked to provide their motivation for attending and to articulate positive and negative aspects about their community. The model building task was then explained and the LEGO® and other items were introduced. The LEGO® and other materials were set out for participants to choose from, ensuring no one felt limited by a predetermined allocation.

Participants were not provided with flood risk maps or hazard information in order to avoid biasing the discussion towards pre-determined risks. As such, the proposed interventions reflect creative, participant-led perspectives, rather than risk-informed planning. This reflects an exploratory, stakeholder-led approach, consistent with qualitative research principles which foreground the diverse perspectives of participants (Lim, 2025; Duea, Zimmerman *et al.*, 2022).

Brief information sheets were provided in all workshops introducing selected examples of BGI and their contributions to flood resilience, wider co-benefits and challenges. These were intended to

stimulate idea generation rather than provide an exhaustive or prescriptive list. Participants were encouraged to combine the information provided with their own perspectives when developing BGI solutions. This approach reflects qualitative research principles, in which stimulus materials are used to encourage participants to reflect, interpret and generate ideas, supporting exploratory and participant led discussion (Törrönen, 2002; Page, Broady *et al.*, 2022).

To facilitate analysis of how the models reduced flood risk and their relationship to current literature on BGI, participants were asked to respond to four questions. These were designed to capture consistent information on each design's features, location, flood mitigation function and additional benefits. The questions also encouraged reflection, helping capture the reasoning behind design choices and their relevance to local priorities. The four questions were as follows:

1. Do you have a specific location for your idea?
2. Describe the features of your idea.
3. How does it reduce the risk of flooding?
4. What other benefits does it bring?

Participants were given one hour to build their models and respond to the questions. Following completion of the model building, participants were invited to explain their model and provide their responses to the questions. At the end of the workshop, the models were dismantled and the completed question sheets were collected to allow for later analysis. These activities shaped the dataset that forms the basis of the analysis presented later in the paper.

4.5 Data analysis

Building on the workshop process described above, this section outlines how the data were analysed. The completed question sheets were subject to a Template Analysis (TA). TA involves the development of a coding template which summarises the themes identified by the researcher as important in the data set and organises them in a meaningful and useful manner (King, 2024). Given that all workshop participants were asked to respond to the same questions, a single coding template was developed for the full dataset. Although the data was analysed as a holistic unit, codes and

themes were tagged with each group's identity code. This meant that it was possible to differentiate between the models. There is no definitive right or wrong approach in deciding between one template or multiple group-specific templates (King, Brooks *et al.*, 2018; King, 2026). For example, King, Brooks and Tabari (2018) employed a single coding template in their analysis of more than 72 interviews conducted with hosts and guests across hospitality organisations in London and New York. This demonstrates how one template can effectively synthesise insights from diverse but thematically connected groups.

Analysis drawn on a hybrid approach of an *a priori* coding template, with the questions set in section 4.4 used to inform initial themes. Further themes were developed inductively during analysis of the question sheets. Figure 4 shows an overview of the analytical process.

Figure 4: Overview of the analytical process

5. Results

Although eight models were created during the workshops, sections 5.1 to 5.5 present a detailed analysis of five models. These were selected to reflect a diversity of contexts and perspectives. Each model is presented individually to retain the place-specific detail and reasoning that underpin the qualitative analysis, before these insights are synthesised in the discussion.

The first model was created by Group MC in the Maxwell Centre workshop. The second and third were made by BF1, an individual, and BF4, a group of three, in the Broughty Ferry workshop. The fourth model was made by an individual, DU1, in the workshop at the University of Dundee. This approach supports a rich exploration of how participants conceptualised BGI, their priorities for adaptation and the multiple benefits that BGI can deliver. Italicised text in quotation marks denotes the exact words used by participants. Figure 5 shows the approximate locations for each BGI intervention.

Figure 5: Approximate locations for the BGI interventions.

5.1 Participant: MC

The model built by MC is shown in figure 6. The location for their design was the Dighty Burn Valley, within some greenspace. MC explained that this area was chosen as it is “*close to some houses and often floods*”. The BGI features the model includes are overflow ponds (1), a floodplain meadow (2), watercourse restoration (3), trees (4), planters (5), an active travel path (6), permeable paving (7), an ornamental fountain (8), and a water feature (9). The model also includes lighting, shops, a play area and a picnic area.

Figure 6: Model made by MC

5.2 Participant: BF1

Figure 7 shows the model made by BF1. BF1 noted their model did not respond to a specific flooding incident but was created to tackle surface water flooding. The model represents a section of Broughty Ferry High Street. The BGI features included in this model are a sustainable urban drainage system (SuDS) (1), an active travel path (2), permeable paving (3), planters (4) and trees (5). Other features in this model are a green lamppost, a green bin and a seating area.

Figure 7: Model made by BF1

5.3 Participant: BF4

BF4 created two models, as shown in figure 8. The model on the right was to tackle water pooling in a section of Bridge Street, Broughty Ferry. The model on the left represents a local school. The intervention in this design was not to tackle a known instance of flooding but was intended to reduce run off and surface water flooding. The BGI features included are planters (1), a raingarden (2) and a SuDS pond (3).

Figure 8: Model made by BF4

5.4 Participant: DU1

The design in figure 9 was made by DU1 and represents Peddie Street in Dundee. This location was selected as “*water pools at this location*” as it is at the bottom of a slope. The BGI features in the model comprise of a pond (1), trees (2) and a planter (3). This design also includes lighting, a play area, a coffee shop, cycle storage and a picnic area.

Figure 9: Model made by DU1

5.5 Participant: DU2

Figure 10 shows the design made by DU1. It represents an area of disused land behind Dundee Science Centre. This location was selected as it would help to mitigate flooding from surface water and the River Tay.

The design of DU2 design shows a water plaza inside a park area and a “*floodplain meadow (1) and swales (2) which fill up during storms, capturing the runoff from local streets and potential floods over the sea wall*”. DU2 also noted the design functioned “*as a sink for urban runoff*”. This design also included trees (3), planters (4), as well as a coffee shop and a picnic bench.

Figure 10: Model made by DU2

6. Discussion

The model descriptions provided in the previous section form the descriptive foundation for the Template Analysis outlined in the methodology. In this section, these insights are brought together into a set of cross-cutting themes that reflect how participants conceptualised BGI, its functions and wider co-benefits.

6.1 Health and wellbeing

Health and wellbeing was a frequent theme of the models and included the physical and mental wellbeing impacts of BGI. In MCs model, cars were removed from the area to reduce air pollution to improve health and wellbeing. Similarly, BF1s model incorporated green and blue areas to reduce air pollution and to “*make Brook Street a nicer place to sit*”. These design choices reflect findings by Liao and Kim (2024), who highlight the importance of green infrastructure in improving air quality. MC explained that people were meditating around the water feature in their design, further demonstrating the mental wellbeing impacts of their approach. MC also noted that people “*enjoyed the scenery*”, a sentiment also expressed by BF1 and BF4. These findings support the broader argument that BGI can stimulate psychological benefits in tandem with their capacity to reduce the risk of flooding, as noted by Li and Lange (2023).

Several models incorporated lighting into their models. For MC, the inclusion of this was to support year-round use of the space and enhance safety. This suggests that participants believed their designs might encourage anti-social behaviour and that addressing this issue was necessary to promote utilisation. This supports research cautioning that fear of crime may prevent the use of greenspace, as highlighted by Maruthaveeran and van den Bosch (2014). However, the impact of lighting on safety in greenspaces is complex. For instance, Lis *et al.* (2023) notes that while lighting can make visitors feel safer, it can also diminish the feeling of privacy and can make a space feel less inviting. Additionally, some studies caution that lighting does not necessarily reduce crime and effects may vary by context (Fotios, Robbins *et al.*, 2021). This suggests that lighting should be considered as part of a broader set of strategies rather than a stand-alone solution.

6.2 People and communities

The social benefits of BGI were a core feature of several models. For instance, DU1 correlated an “*increase in blue green spaces with an increase in outdoor socialising*”. BGI was viewed not only as a tool for environmental improvement but to also create inviting community spaces that encourage social interaction and spontaneous encounters. This finding underscores the capacity of green spaces

to function as informal gathering points that encourage social interaction, aligning with the findings of Jabbar, Yusoff and Shafie (2022).

BF1 noted that water collected in water butts would be used by community groups to irrigate the planters along the high street. This emphasises the role of community stewardship in the care of BGI, as noted by Lamond and Everett (2019). However, it also demonstrates that BGI can place a burden on community groups. Research suggests that limited volunteer capacity may hinder the ability of communities to support projects within the community (Lovell, Gray *et al.*, 2015; Imbaya, Nthiga *et al.*, 2019). Therefore, while the idea of BF1 highlights the important role community groups play in maintaining BGI, its success in practice may be limited by a lack of volunteer capacity. Moreover, reliance on community groups may exacerbate inequalities between areas, as communities with greater social capital may be better placed to sustain BGI interventions. This is supported by Collier, Frantzeskaki, Connop *et al* (2023) who suggest that uneven resources and community capacity may lead to disparities in the ongoing maintenance of urban nature-based solutions.

6.3 Active Travel

The designs of MC, BF1, B4 and DU1 all incorporated active travel. For instance, BF1 and MC included permeable surfaces within the active travel routes in their model. For example, BF1 noted that “*cycle lanes will have a permeable surface to let some water in*”. This comment echoes a growing consensus of the intersection between climate resilience and sustainable transportation (Etukudoh, Adefemi *et al.*, 2024). The design of BF4 included rain gardens to separate users of the active travel path from the road to “*protect them from exhaust fumes*”. Similarly, BF1 integrated “*green space to calm the High Street and make more space for cyclists and pedestrians*” to enhance safety. These results concur with the literature on active travel infrastructure. For example, that dedicated cycle lanes enhance safety by reducing the risk of vehicular collisions and minimises exposure to being hit with a car door (Nanayakkara, Langenheim *et al.*, 2022). The significance of this alignment is that participants, despite working with non-technical, creative tools, independently generated design ideas that reflect established best practice in active travel planning. This suggests that playful, hands-on

methods can elicit proposals that are not only locally grounded but also technically credible, reinforcing their value for community-led adaptation planning.

For DU1, active travel includes a range of options such as skateboarding and walking. Thus, DU1 recognised the diversity of physically engaging modes of active transport. It also emphasises that active travel is not solely about purposeful movement between destinations but also recreational engagement. This reflects its multifaceted role within contemporary mobility practices, as noted by Ding *et al* (2024). MC explained that it was important for active travel to be accessible and inclusive for all, including for people with limited mobility. This commitment to incorporating inclusivity within active travel initiatives has also been acknowledged within the academic literature (Malden, McDougall *et al.*, 2024).

BF4 saw the inclusion of an active travel route connecting housing estates with local shops as a step toward becoming a 20-minute neighbourhood. This was the only design where participants acknowledged this concept. Nevertheless, through integrating active travel routes in their designs, the ideas of MC, BF1 and DU1 are consistent with the underlying principles of the 20-minute neighbourhood approach. That is, the prioritisation of accessibility and walkability to reduce the need for car use (Al Waer and Cooper, 2024). In recent years, the idea of the 20-minute neighbourhood has attracted increasing attention (Hyde, 2025; Alwaer and Cooper, 2023). However, its limited mention in the workshops suggests that, despite its theoretical influence in urban planning theory, the concept has yet to gain widespread recognition at the community level.

6.4 Food growing

The theme of food growing emerged across multiple workshops and models, reflecting a cross-cutting-concern between participants. For instance, food growing was noted at several points in the design of MC. MC explained that food grown as part of their design was to be a “community resource”. Thus, for MC, food growing may suggest that there is a demand for free to access food within the locality. This may have been influenced by the location of the workshop, within a community which has a high concentration of residents living in data zones classified within the most deprived

20% in Scotland (Dundee City Council, 2020). According to Morgan (2014), food growing can enhance food security and serve as a strategy for addressing social deprivation. The incorporation of food-growing components in the design of MC reflects this understanding, emphasising the value of integrating such features within economically disadvantaged areas.

Despite the potential benefits of food growing as part of BGI, there is a disconnect between policy support and real-world implementation. Although food growing is increasingly promoted as part of BGI and green infrastructure, researchers argue that it remains overlooked in practice (Evans, Falagán *et al.*, 2022; Bohn and Chu, 2021). For instance, despite policy support for community gardens in European cities such as Barcelona, Trieste, Udine and Lyon, the realisation of these is restricted due to land use policies that do not tend to support urban agriculture (European Commission, nd). This is echoed in a Scottish context, due to limited land availability for BGI (Consumer Scotland, 2022). Additionally, the delayed realisation of the full benefits of BGI, such as food growing, can be hampered due to site maturation requirements (Consumer Scotland, 2022). These issues demonstrate that the success of food growing as part of BGI depends heavily on the broader structural and policy context.

6.5 BGI can bring an economic impact

The potential of BGI as a catalyst for economic growth was a feature of several designs. MC explained their BGI design “*had attracted additional people to the area as it looked nicer*” and, due to this, “*more shops had opened*”, including a café. Likewise, DU2 noted their design had led to an increased number of people within the area, meaning “*a coffee shop had opened within the park*”. No adverse perceptions of BGI as an economic stimulus were evident in participant reflections. This contrasts with the academic literature, which notes concerns relating to BGI as a stimulus for economic development. BGI is often framed in terms of its contribution to economic growth (Toxopeus, Kotsila *et al.*, 2020). However, BGI can frame nature as a panacea for complex socio-economic challenges, including deprivation and health disparities (O'Sullivan, Mell *et al.*, 2020). Moreover, urban greening strategies, such as BGI, risks reinforcing structural inequalities as a result of displacement and gentrification (Loughran, 2014; Mahmoud, 2024). These concerns emphasise the

complexity of BGI as an economic development intervention. Additionally, concerns about green gentrification further complicate the economic impacts of BGI. While some studies show that new green spaces can intensify social vulnerabilities or benefit more affluent groups (Haase, 2017; Anguelovski, Connolly *et al.*, 2018), others argue that these outcomes stem from wider socio-economic processes rather than greening alone (Nygaard, 2024). These findings underscore the complex relationship between urban greening and wider structural change.

6.6 BGI can support biodiversity, nature and wildlife

In their designs, DU2 and MC acknowledged the connection between trees and their role in promoting biodiversity and attracting wildlife. MC included flowering plants, explaining that this was to attract wildlife. Flowers and plants were a common feature included across all designs. The main reason for this from the participant's perspective was to promote and enhance wildlife and biodiversity. These observations echo previous studies that note the value of planting as an effective means of increasing biodiversity (Vega and Küffer, 2021; Paudel and States, 2023). Within this theme, DU2 was the only participant to note the importance of native and context-specific planting, stating that planting would be of a "*native species, able to withstand waterlogging*". As Hamel and Tan (2022) emphasise, the selection of native, flood and drought resilient species is a key consideration in BGI. The limited discussion of this aspect in the workshops suggest an opportunity to provide additional guidance or awareness about the range of ecological considerations involved in BGI. This reflects wider critiques that planning policy can marginalise the more-than-human dimensions of placemaking, underscoring the need to integrate non-human perspectives into planning practice (Humphris, Rauws *et al.*, 2024).

6.7 Flood mitigation functions

Models included rain gardens, swales, permeable surfaces, SuDS, overflow ponds and floodplain meadows. This shows that participants broadly understood the key principles of BGI in water management. This alignment between participant's ideas and established BGI strategies is significant, given the non-technical framing of the workshops. This suggests that participatory design methods can elicit creative and context-specific BGI proposals and support the generation of

technically insightful contributions to resilience planning. While the explanations behind the designs did not utilise technical terminology, they still spoke about BGI functions with clarity. This indicates that the use of serious games and serious play did not dilute the technical relevance of the contributions. Instead, it enabled participants to engage with spatial and ecological dimensions of flood risk in ways that were accessible and grounded in place-specific knowledge. This aligns with previous findings that local knowledge, when elicited through creative and inclusive methods, can produce outputs that support transformative adaptation (Ziervogel, Enqvist *et al.*, 2022). Importantly, the spatial specificity of proposals, such as permeable paving on a busy high street or installing overflow ponds next to a river, shows that local communities were able to identify context-specific opportunities for BGI. This reflects the value of place-based knowledge in shaping context-specific opportunities for BGI. In doing so, it echoes research demonstrating that creative, situated approaches may help communities engage with environmental challenges (Davies and Hügel, 2021; Burke, Ockwell and Whitmarsh, 2018).

7. Reflection on the methodological approach

This study set out to investigate how human-centred, playful participatory methods can facilitate inclusive, place-based climate adaptation planning. Despite the novelty of the workshop process, the results show that the process facilitated meaningful and inclusive participation. For instance, participants in all workshops said that they enjoyed taking part and that the workshops had opened their mind to the possibilities for tackling flooding through BGI. Importantly, the creative, hands-on format helped participants move away from viewing flooding solely as a technical, engineering or hydrological problem. Instead, their discussions and models foregrounded social, environmental and place-based dimensions. For instance, wellbeing, biodiversity, community cohesion and everyday lived experience. This shift illustrates how playful, creative and tactile methods can re-frame adaptation challenges in ways that feel relevant to participants' own lives and environments. It also suggests that these approaches may prompt thinking that goes beyond expert-driven, infrastructure-led solutions. In doing so, this study aligns with Zhu and Ling (2025), who write that creative practice can foreground cultural values and local narratives to create socially meaningful urban spaces.

In the workshop at the Maxwell Centre, participants wanted to keep their model to show the wider community what was possible for their area. As the LEGO® was required for other workshops this was not possible. However, this demonstrates that participants felt their ideas held validity. It also highlights that the model was viewed as a tool for communication with relevance beyond the session. The physical models built during the three workshops also served as tools for storytelling and idea sharing between participants. During the model sharing section of the workshops, participants pointed to specific BGI features while articulating the benefits these brought. This evidences that these tangible representations assisted in conveying abstract ideas, facilitating a collective sense making process. Figure 11 provides a visual illustration of participants engaged in the workshop process, highlighting the collaborative, hands-on nature of the methodological approach.

Figure 11: Participants engaged in the hands-on workshop process

Allowing participants to work within groups or individually provided valuable insights into how different forms of engagement shaped the participative process. Group work encouraged dialogue, negotiation and the integration of multiple viewpoints into a shared vision. Individual model building created space for personal reflection. For instance, BF1 used LEGO® figures to represent family members, explaining how their BGI interventions would help to improve their everyday life. There was then a group discussion on how the design of BF1 could be taken forward and the implications of this. This sequencing, from individual reflection to group discussion, demonstrates iterative development and progression from an initial concept to collective input which informed new ideas. This finding aligns with De Sutter et al (2022) who observed that engaging participants individually and then collaboratively can generate new ideas through the sharing of experiences. The workshop outputs also revealed an interplay between collaboration and creativity, fostering inclusivity and supporting meaningful social interaction, in line with key principles of placemaking (Erek and Krasznahorkai, 2024).

The workshop materials were used by participants in imaginative ways. For instance, while LEGO® was used to construct spatial layouts, other items were used to represent organic features. Stickers were adapted by BF1 to demonstrate that traffic flow on a road had become one way. BF4 used pen

and paper to quickly sketch a realistic representation of the road their intervention was designed for. Although modelling organic features such as water or vegetation has been cited as a limitation of LEGO® in participatory processes (Boa, 2017; Mathias *et al.*, 2019), this was largely addressed by the inclusion of specific LEGO® elements. For instance, translucent blue bricks which participants used to represent water. As a result, few participants used alternative materials to represent organic features. These examples illustrate how the mixed materials supported clear communication and enabled participants to convey ideas that might otherwise have been difficult to express.

Taken together, these reflections demonstrate that the methodological approach was effective in eliciting rich, place-based insights and fostering inclusive participation. They also advance wider UK and European research on community engagement in climate adaptation by addressing core gaps around practical, locally led, creative and playful methods for co-design. Table 2 summarises how this study's findings compare with relevant UK and European research, drawing on the literature discussed earlier in the paper.

Table 2: Comparison of this study's findings with relevant UK and European research

Author	Region	Method used	Key findings	Contribution of this study
Everett, Adekola & Lamond (2021)	United Kingdom	Literature review to understand conceptual engagement and develop a template for community engagement in BGI.	BGI engagement characterised by limited community influence, highlighting the need for co-productive and inclusive approaches.	Moves beyond principles for community engagement in BGI by applying a participatory approach that generates context-specific, actionable outcomes.
Neset et al. (2020)	Sweden	Serious games in a climate adaptation context.	Serious games engage players and help them reflect on climate adaptation challenges.	Similar benefits observed. However, this study adds evidence that playful, hands-on methods, such as LEGO®, facilitate the surfacing of tacit, place-based knowledge.
Sillanpää et al. (2024),	Finland	Gamified adaptation tool.	Games shows promise in boosting	Supports these findings and

			engagement and motivation through agency and collaboration.	provides UK-based evidence that playful, methods enhance inclusivity, build participant confidence and strengthen agency in adaptation planning
AlWaer, Wright & MacPherson (2018)	UK	Placemaking workshops	Creative methods support inclusive dialogue.	Reinforces and extends these findings. Shows that creative, hands-on methods can facilitate inclusive dialogue while enabling communities to co-design place-based BGI solutions for flood resilience
Parsons et al. (2025)	UK	Systematic review	Participatory approaches can empower communities, yet participation often remains insufficiently inclusive.	Demonstrates a practical, bottom-up approach that enables inclusive and empowering participation through playful methods.

Despite the strengths of hands-on participatory approaches, engaging communities around BGI poses challenges within an increasingly digital planning landscape. Recent literature highlights that the growing use of digital tools and artificial intelligence raises questions about sustaining inclusive, place-based participation without undermining community agency (Shabani, AlWaer *et al.*, 2025). Future work should therefore explore how participatory methods can coexist with, and be complemented by, emerging digital and AI-enabled planning practices.

8. Limitations

Several limitations should be noted when interpreting these findings. Workshop attendance varied across sessions and participation was voluntary, introducing the potential for self-selection bias. The findings are also shaped by context-specific factors, including the Scottish Policy and local socio-spatial characteristics, meaning they should be understood as contextually grounded rather than

generalisable. Nevertheless, they offer insights that can inform local decision-making and support understanding of process and relationships relevant to real-world problem solving, consistent with the nature of qualitative research, (Lim, 2025; Hamilton and Finley, 2019).

9. Conclusion

The findings from this study have implications for public policy, planning practice and related fields concerned with climate adaptation and community engagement. They suggest that a creative, participatory workshop using serious games and LSP®, underpinned by a placemaking philosophy, provide a practical, inclusive approach to engaging communities in BGI planning. The methodology developed within this paper surfaced local priorities and made complex concepts accessible, enabling workshop participants to generate locally grounded, place-based BGI solutions to flooding that enhance liveability.

Critically, the use of creative, tactile tools such as LEGO®, modelling clay and stickers enabled abstract concepts, such as water flow and resilience, to be explored in accessible, tangible ways. This helped to surface knowledge that may be challenging to extract within conventional or top-down engagement formats. Notably, participants did not treat climate risk in isolation. Their models routinely coupled flood mitigation with biodiversity, public amenity, perceived safety, active travel and local economic activity. Analytically, this suggests that the method does more than widen participation. It encourages participants to approach adaptation as an interconnected systems issue, generating design ideas that bring together technical function with social and economic co-benefits.

Participants' openness to sharing, displaying and explaining their models suggests a clear sense of ownership and pride. This indicates that they were confident in the workshop approach and regarded their ideas as valid contributions. In a separate application of the workshop methodology, delivered after the three sessions reported in this study, participants independently took their ideas to the local council. The council advised they were already pursuing similar actions. Nevertheless, the fact that participants felt able to initiate this dialogue suggests that the method can strengthen civic engagement and confidence in contributing to local decision-making

The workshop method presented here is potentially transferable beyond the Scottish context, though this is conditional. Transferable elements include hands-on modelling, the placemaking framing and small group structure. Conditions for successful adaptation include facilitator skills to manage power dynamics and translate technical concepts. In contexts with different cultural norms, both materials and facilitation approaches will require deliberate adjustment. Testing the approach in other socio-spatial and institutional settings could improve understanding of its broader applicability and explore how co-created designs can inform formal adaptation strategies. This potential for transferability is significant given that international policy frameworks, such the Sendai Framework for Disaster Risk Reduction and the UN Sustainable Development Goals, explicitly call for locally led, participatory approaches to climate adaptation. The method developed in this study offers a practical contribution to these global aspirations by illustrating how inclusive, community-centred engagement can be operationalised at the local scale.

Overall, the findings from this research reinforce calls to make climate adaptation planning more inclusive and collaborative through locally led approaches. They demonstrate the value of playful, participatory methods in bridging the gap between policy aspirations and lived experience, and between technical adaptation solutions and social imagination. As international climate policy increasingly emphasises community engagement as a cornerstone of effective resilience planning, approaches such as the one presented here provide timely evidence of how participatory, human-centred methods can support this agenda. Future work should examine how this approach performs in different community contexts and how co-created designs can be meaningfully integrated into formal adaptation strategies.

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Alba / Scotland

Aberdeen

Durness

Edinburgh

Glasgow

United Kingdom

Newcastle
upon Tyne

Carlisle

Derry/
Londonderry

100 km

50 mi

Northern
Ireland

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Placemaking as an underpinning philosophy

Serious games & Serious Play as the workshop approach

Physical and social dimensions of urban space

Valuing of local knowledge and lived experience in public space design

Serious game elements:

A challenge and scenario

A chance to work with others to investigate the art of the possible and a debriefing session

Workshop approach

→ Participants tasked with developing a solution to flooding using BGI and a place-based approach.

→ Participants work in small groups or individually to model a solution to flooding. Ideas are then discussed as a collective group

Serious Play elements:

Playfulness and imagination

Tools for playfulness and creativity

→ Embedded through a creative model building activity

→ Lego® and range of craft items to build models to allow risk-free solution prototyping

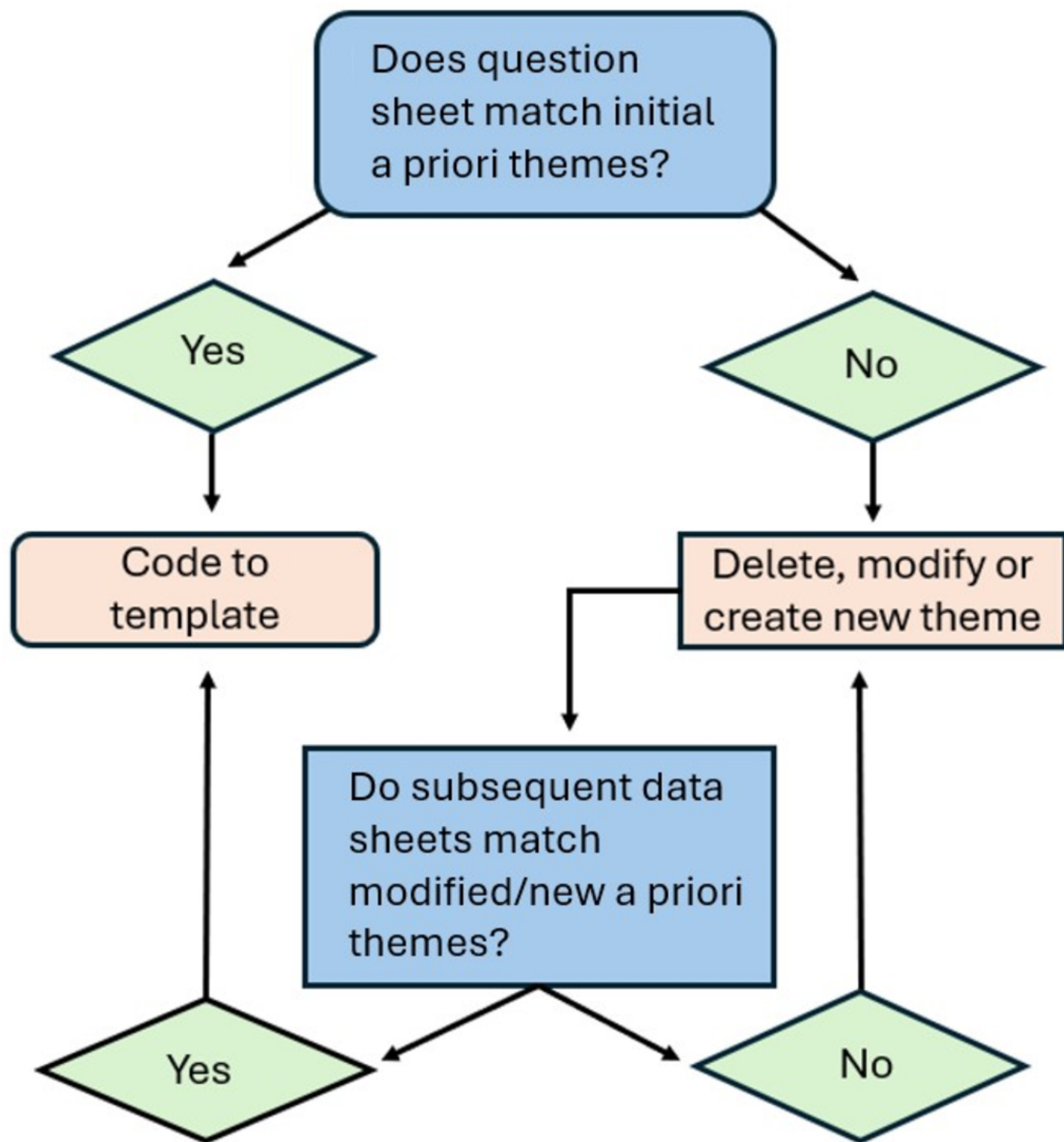
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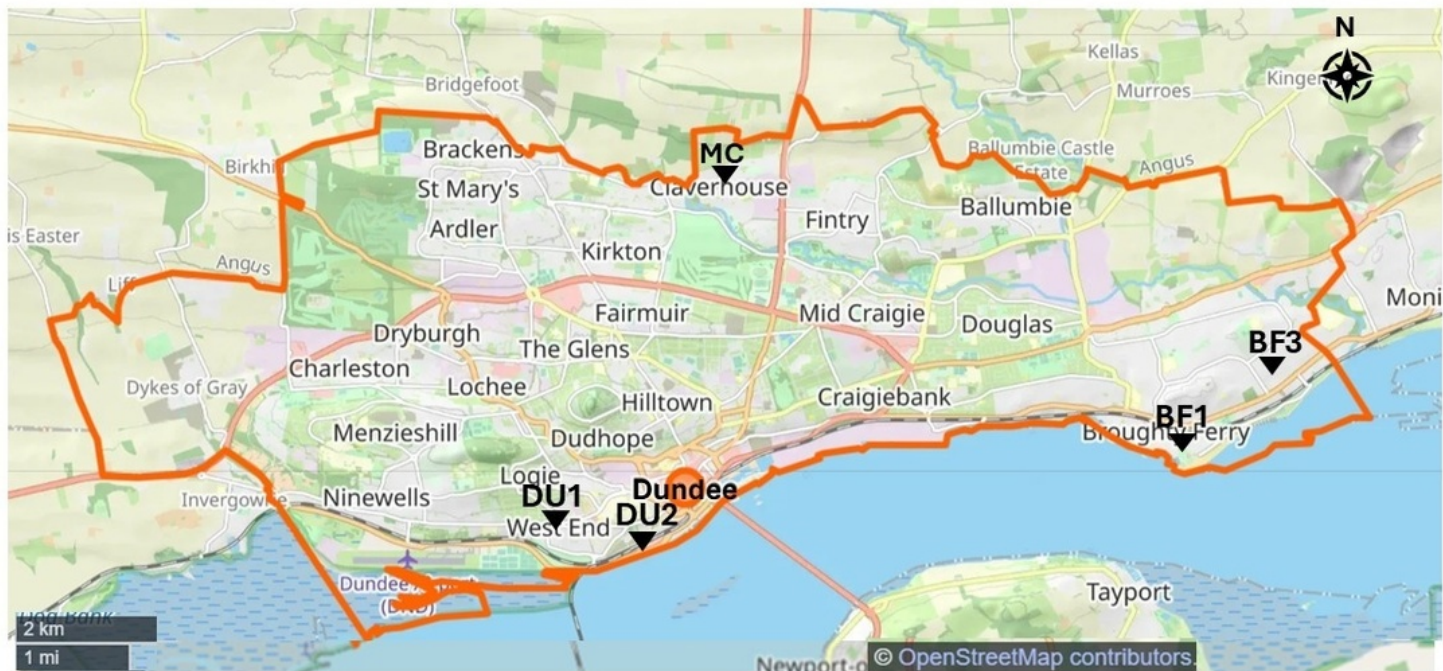
Sense of place

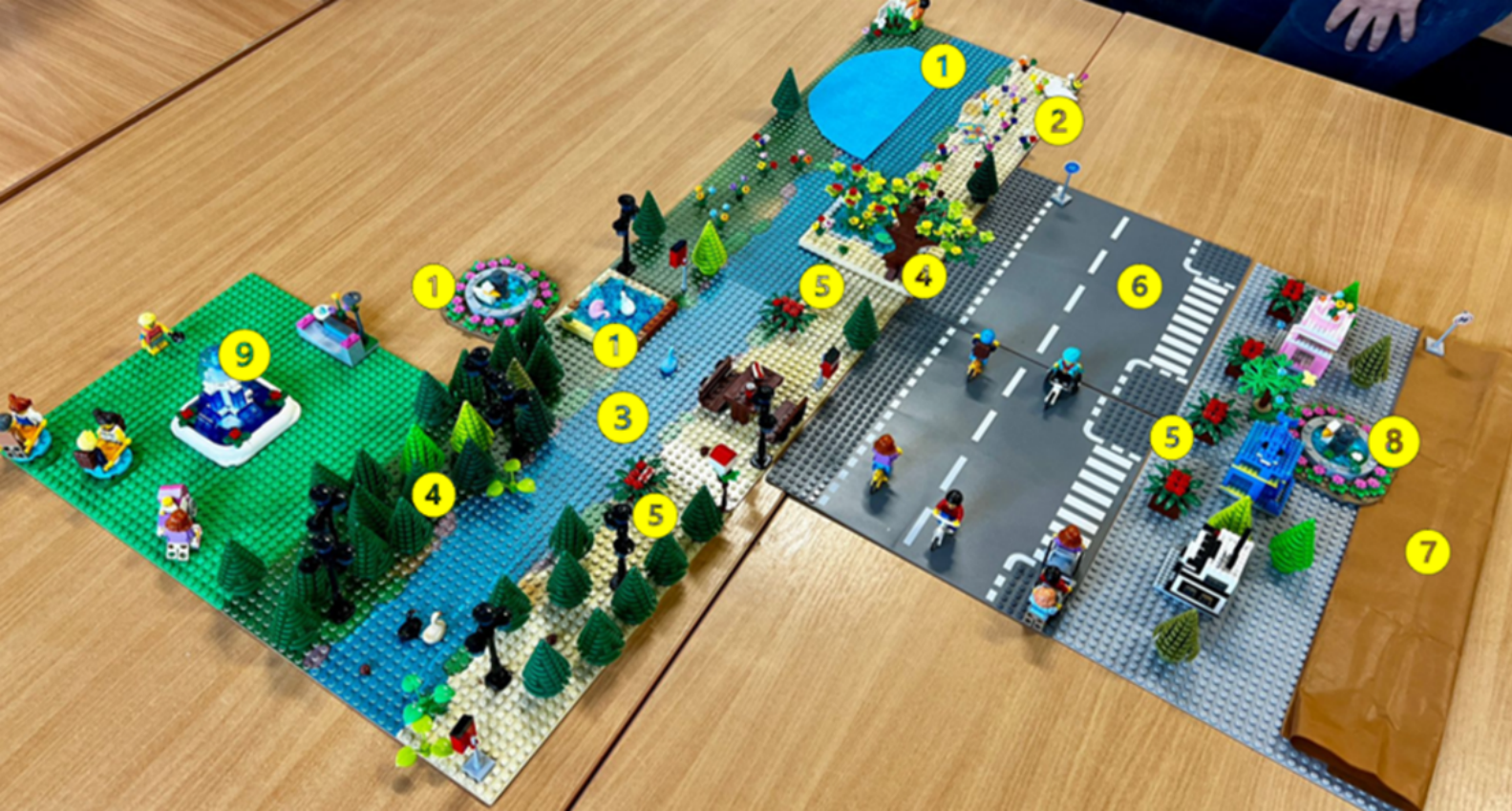
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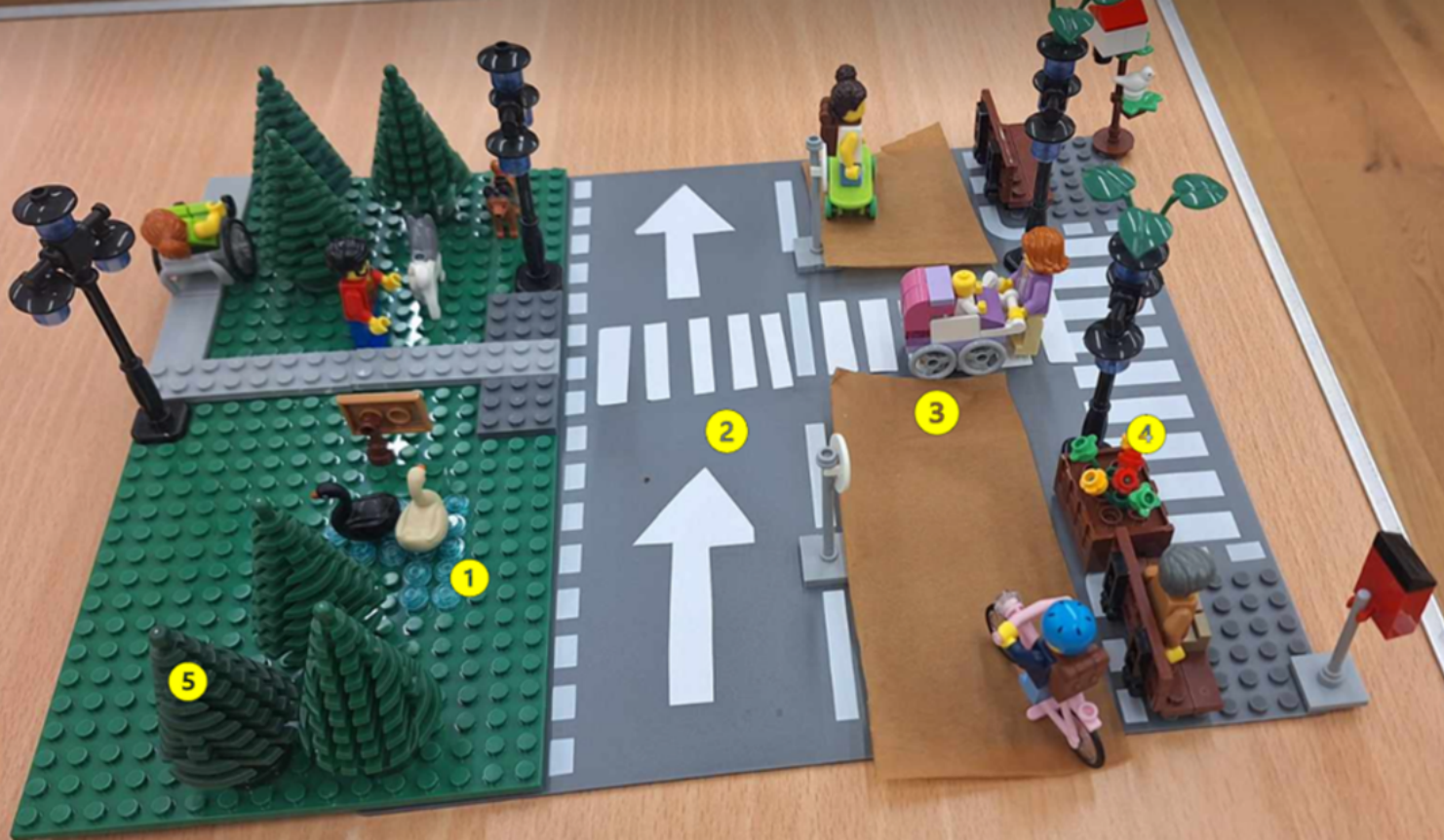
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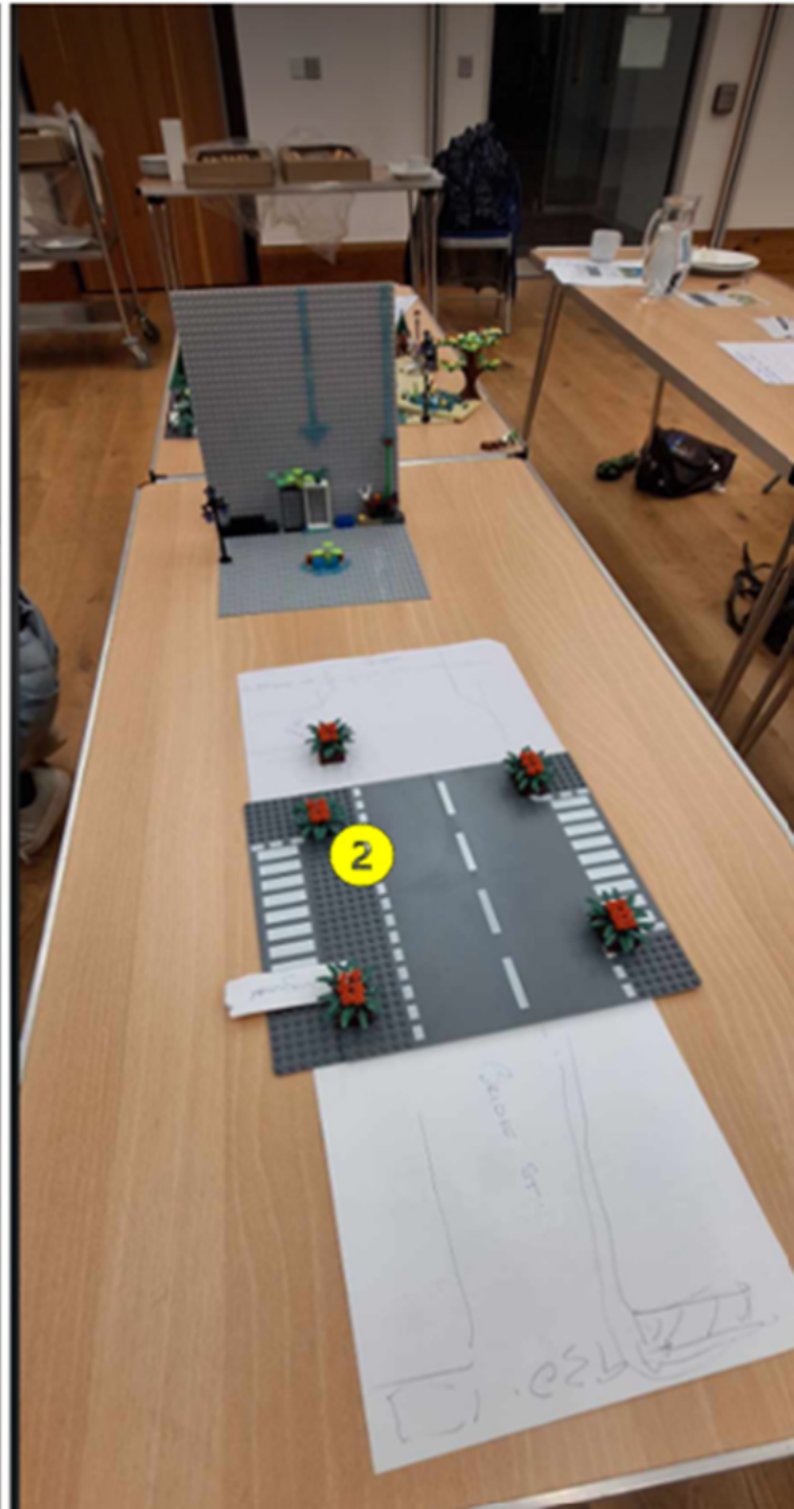
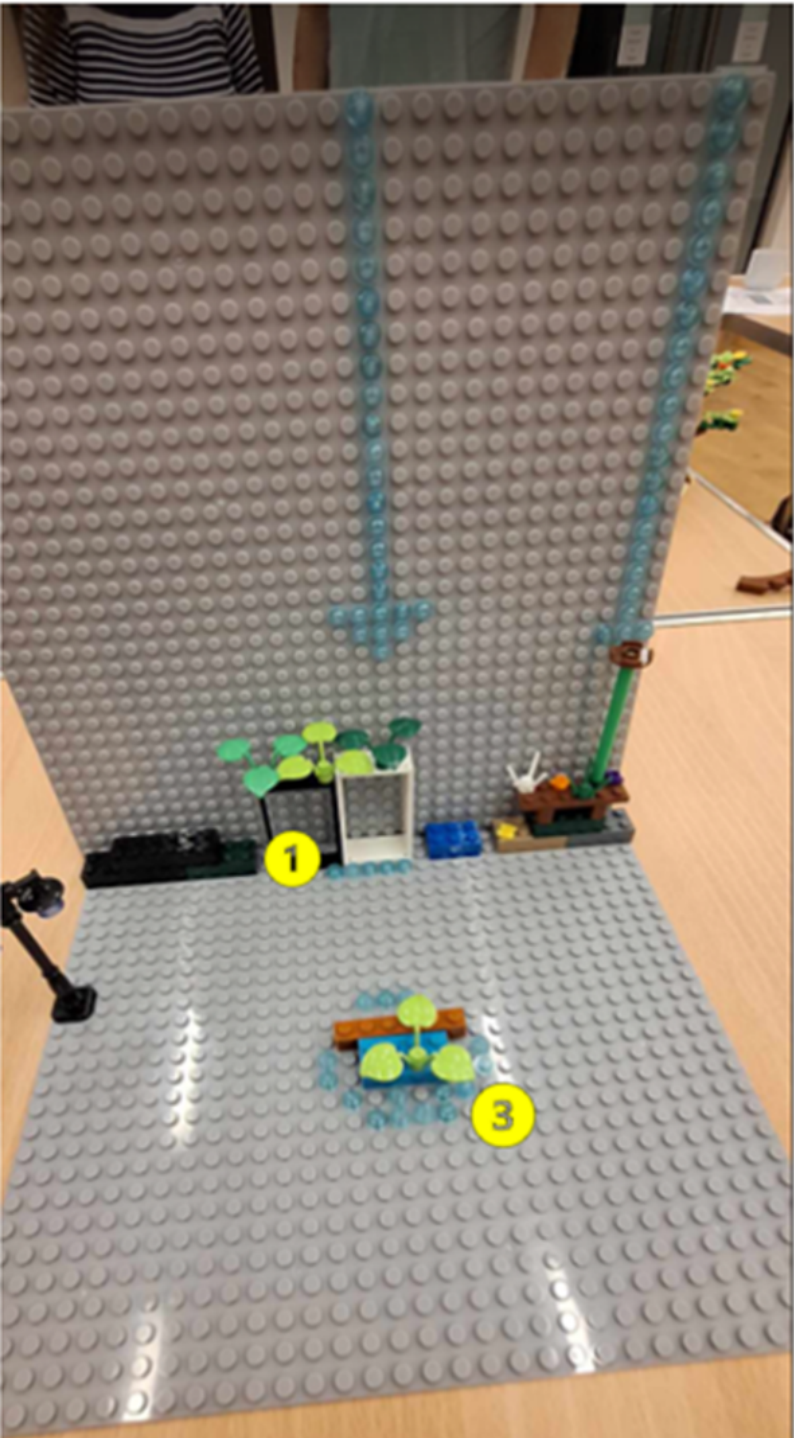
Fostering of environmental and socially responsible actions















4

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3

1

