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Place-Keeping in the Park: Testing a Living Lab Approach to Facilitate Nature Connectedness in Urban Greenspaces

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Place-Keeping in the Park: Testing a Living Lab Approach to Facilitate Nature Connectedness in Urban Greenspaces

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Abstract: Green infrastructure, particularly public greenspaces such as urban parks, plays an important role in urban environments, and improving public participation in greenspace practices and encouraging environmental stewardship can help to address some of the challenges of greenspace governance. We identify a gap in the research as to whether participation in citizen science projects can enhance connections between people and place and encourage better community participation in the stewardship of parks and urban greenspaces. The research adopts a Living Lab approach to utilise the inherent knowledge of the local community in developing digital experiments in the pilot site using a Nature Data Probe toolkit and seeks to explore its potential for enhancing nature connectedness by revealing hidden nature. We describe an action research method working with participants from a secondary school located close to a large urban park in Plymouth, UK. The results found that participants were more observant of hidden nature following the workshop and that an increase in the number of participants, and in the specific and descriptive responses identifying nature, was observed. These findings indicate that a deeper awareness of the natural environment was created and, in summary, we discuss the implications of this as a pathway to increased participation in greenspace governance.

Keywords: urban greenspace; Living Lab; citizen science; nature connectedness; public participation; greenspace governance

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1. Introduction

1.1. Public Participation, Citizen Science, and Greenspace Governance

Recognising the barriers to equitable greenspace access and the need to improve participation in greenspace governance, public engagement in the provision, design, and management of greenspaces has risen to the top of the political agenda in recent decades (Mathers, Dempsey & Molin, 2015; NE, 2020; PHE, 2020; Swyngedouw, 2005). This is illustrated in the ongoing shift towards a governance structure centred around participation, underpinned by a 'governance-beyond-the-state' which involves the local community and non-governmental stakeholders in greenspace management (Geddes, 2006), as opposed to the traditional management of greenspaces by the local governments (Mathers, Dempsey & Molin, 2015; Swyngedouw, 2005). Thus, non-state actors have increasingly been playing an important role in the decision-making processes (Mathers, Dempsey & Molin, 2015), rooted in their local knowledge and relationship with space for a sustainable impact in parks and greenspaces. This includes participation in the development, management, and, most importantly, conservation of these greenspaces to ensure that they meet the needs of the user community. With increasingly restricted local authority budgets and the consequent governance challenges around the provision of urban parks and greenspaces, the active involvement of the community in 'place-keeping' in urban greenspaces has become even more crucial (Geddes, 2006; Mathers, Dempsey & Molin, 2015; Ward Thompson & Travlou, 2007). Improving public participation and

encouraging environmental stewardship can help to address these challenges of greenspace governance and mitigate the resulting decline of greenspaces. While recent evidence indicates a positive shift in general perceptions of the nature–human relationship, the public engagement in actively conserving and protecting the biodiversity in greenspaces remains low (Martin et al., 2020; NE, 2020; Richardson et al., 2020). When individuals actively and directly support the restoration of biodiversity, it can lead to a wider engagement of the community in more actively caring for the parks and the locale (Alcock et al., 2020; Miller, 2005; Richardson et al., 2020). In this context, citizen science can provide a unique opportunity to not only enhance greenspace engagement but to also create better models of greenspace governance (Lupp et al., 2020; Sorensen et al., 2019).

1.2. Research Problem—Urban Greenspace Governance and Access

Urban parks and green infrastructure have been shown to have a wide range of social and environmental benefits, including improving health and wellbeing, air quality, nature recovery (Ward Thompson et al., 2012), and climate change resilience and mitigation, along with addressing issues of social inequality and environmental decline (Martin et al., 2020; NE, 2020; PHE, 2020). However, greenspaces and public parks in the UK have been under increasing pressure in recent years, with public sector resource constraints disproportionately affecting the greenspaces in the country (NE, 2020; PHE, 2020). In the face of up to 60% reductions in spending on parks services, which are further expected to increase, there is a need to explore new models of management, including working with community, social, and private enterprises (Neal, 2013; PHE, 2020). In the UK, access to greenspaces varies considerably across the country and, therefore, there are opportunities for these important assets to be better managed to deliver a wider range of multifunctional benefits to the community (PHE, 2020). Access is an important factor in governance, wherein inequitable access to greenspace presents multiple barriers that prevent people from using and benefitting from this community resource. These barriers include a lack of greenspace in some communities in proximity to people's homes and workplaces; physical access barriers, such as poor infrastructure in greenspaces themselves; and a perception among certain community groups that the greenspaces and the provisions within them are 'not for them' because of their race, gender, or age (NE, 2020; PHE, 2020).

1.3. Research Aims and Research Question

This research aims to explore how these factors play into the overall dynamics of greenspace engagement and governance in the pilot site. It seeks to examine the placemaking potential of encouraging intentional engagement with greenspaces through simple nature-based activities (Day et al., 2022; Lupp et al., 2020; Richardson et al., 2020), with the objective of creating empathy for the natural environment. Thus, this work explores the use of softwares as a tool to facilitate greenspace engagement and pro-nature-conservation behaviours in communities and, in turn, better management of these greenspaces. We adopt a place-focused approach to examine the method's potential to enhance engagement by application and trial of a 'Living Lab' in a pilot site, working in conjunction with local groups in the co-design process. The research question we seek to address is 'Can we develop a Living Lab toolkit (reveal hidden nature and) facilitate a sense of nature-connectedness to address challenges of participation in the governance of green spaces?'.

2. Literature Review

2.1. Nature Connectedness and Environmental Stewardship

Nature connectedness is defined as 'inherently a measure of value placed on the natural environment and can be compared to both attitudinal and behavioural measures' (Richardson et al., 2019, p. 5). One of the factors exacerbating the disconnect between people and nature is thought to be the increasing population in cities, 'where nature is too

often considered expendable and the ecological processes that sustain us are hidden from view' (Miller, 2005). Miller argues that this leads to an 'extinction of experience' of nature (Miller, 2005) and is responsible for the existing unsustainable lifestyles (Alcock et al., 2020; Miller, 2005). These lifestyle choices and a disconnect with the natural environment also detrimentally impact people's regard for taking care of the nature around them, where nature becomes a background for everyday life. This 'invisibility of nature' in cities and consequent lack of sense of belonging and ownership towards the greenspaces therein is creating further challenges for improving participation of communities in greenspace governance. In this context, influencing individual choices and collective behaviours is key for attaining sustainable development goals globally (Alcock et al., 2020; DEFRA, 2018; UNEP, 2011).

The literature examining the factors influencing pro-nature conservation behaviours (focusing on behaviours translating into efforts towards bio-diversity restoration and environmental stewardship, as opposed to more general pro-environmental behaviour of reducing one's individual environmental impact), lays the emphasis on behavioural 'intentionality', where engagement with greenspaces through simple nature-based activities emerges as the most crucial contributor towards inducing pro-nature conservation behaviours in individuals (Richardson et al., 2020). This positive relationship between people's connectedness to nature, their wellbeing, and their tendency for exhibiting pro-conservation behaviours remains consistent across various socio-demographic variables that influence factors like contact with the nature (through greenspace visits) and general health (NE, 2020). Therefore, it is well evidenced that a feeling of nature connectedness is a prerequisite to motivating engagement in sustainable behaviours directed at nature conservation and restoration (Frantz & Mayer, 2014; Martin et al., 2020; Richardson et al., 2020). Therefore, In this paper we take the approach that enhancing nature connectedness by improving engagement with nature in urban greenspaces is critical to fostering environmental stewardship in communities (Lumber, Richardson & Sheffield, 2017; Martin et al., 2020; Richardson et al., 2020) and, in turn, can help address some of the challenges around greenspace governance in cities.

2.2. Citizen Science and Placemaking: The Living Lab Approach

Citizen science has the potential to deepen connections between people and nature and to increase local participation in greenspace governance (Haklay, 2013; Overdevest, Orr & Stepenuck, 2004). More recently, the literature has referred to theories of place that further also indicate the potential of citizen science in fostering engagement in environmentally responsible behaviours such as voluntary stewardship, communicating with others about important environmental issues, and getting involved in local and/or national environmental policy concerns (Toomey et al., 2020). Besides generating data across large temporal and spatial scales, citizen science can also create scientific literacy around the usage of digital tools, accessing data, and, in turn, promoting environmental awareness (Overdevest, Orr & Stepenuck, 2004; Toomey et al., 2020).

This research explores the role of citizen science in the context of a Living Lab. The EU defines Living Labs as 'user-centred, open innovation ecosystems based on a systematic user co-creation approach integrating research and innovation processes in real life communities and settings' (Robles et al., 2015). In this context, the term 'Living Lab' can refer to a diverse range of local experimental projects given such a project is participatory in nature and aims to trial and test innovative solutions in a real-life setting (Higgins & Klien, 2011; Lupp et al., 2020). Bulkeley identifies three types of Living Lab—'strategic, civic and organic'—and describes how a civic urban Living Lab can provide a way to embed learning and benefits within the urban context (Bulkeley et al., 2018). Typically, urban Living Labs are implemented in urban settings and have often included addressing issues such as air quality or other sensing experiments (e.g., (Balestrini, 2016)) for crowdsourcing environmental data.

However, recently several projects have developed Living Labs in greenspaces or urban parks, such as the CyberParks and C3Places project which used a Living Lab approach with teenagers using ICTs. These projects coined the term 'cyberpark' to define a new aspect of public open spaces integrated with technologies (Costa et al., 2020). The projects found that engaging teenagers in placemaking required thinking outside the box (Costa et al., 2020) and can result in more informed and engaged participation in urban governance. The iSCAPE project identified the following essential characteristics for Living Lab activities: multi-stakeholder participation, active-user involvement, a real-life setting, co-creation, and a multi-method approach (Schaaf & Beshparova, 2019). Lupp et al. identify the potential of Living Labs for nature-based solutions and describe a case study where the main benefits of the approach are seen to be strong engagement and empowerment of citizens or end-users which they argue can lead to more informed decision making in implementing change (Lupp et al., 2020). Although Living Labs have been demonstrated to have benefits for nature-based solutions and greenspace, many are still at quite an experimental stage, and there is a need for more empirical work on their impact on greenspace governance.

2.3. Gap in Knowledge—Promoting Nature Connectedness with a Citizen Science Toolkit

We identify a gap in the research as to whether participation in citizen science projects can connect the community more closely with urban greenspaces and encourage them to better participate in being stewards of these places. While the existing discourse around the use of citizen-science-based interventions for greenspace management primarily focuses on 'revealing information' that could help reduce the negative environmental impacts of human activities (Amirrudin, Harrigan & Naqvi, 2021; Toomey & Domroese, 2013; Toomey et al., 2020), this research aims to explore its potential for promoting nature connectedness by revealing hidden nature and, therefore, utilise it as a means for fostering behaviours that actively contribute to greenspace management and restoration.

3. Materials and Methods

3.1. Methodology

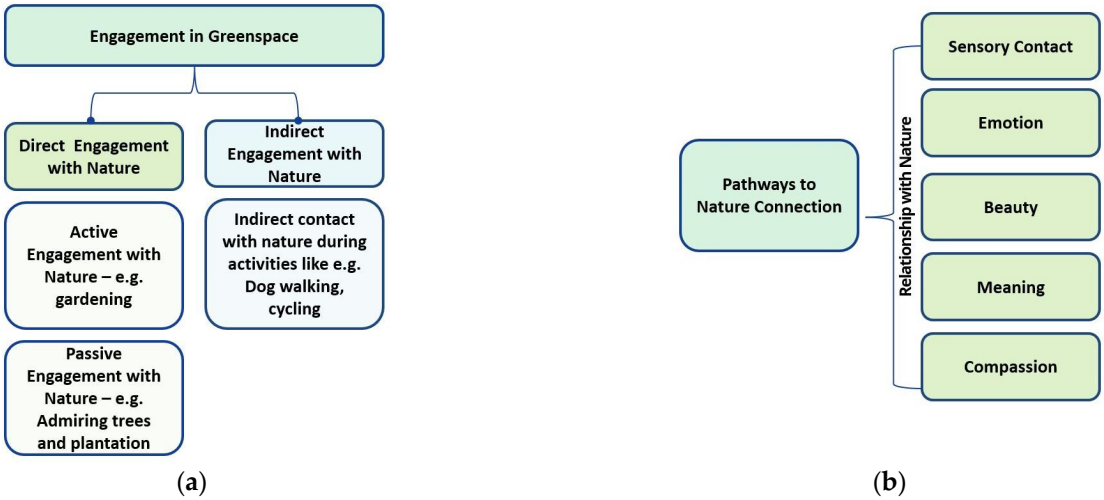
This research adopts a participatory action research methodology, with its characteristic orientation towards reflexivity and social change, such that the citizens are at the centre of the research process (Amirrudin, Harrigan & Naqvi, 2021; Eberhardt & Evans-Agnew, 2018). In this context, the 'Living Lab' as an action research method was adopted to analyse whether place-based citizen science using a Living Lab toolkit can improve nature connectedness in the research participants and empower them to act as stewards of their local greenspaces and, in turn, generators of social change (Eberhardt & Evans-Agnew, 2018; Sorensen et al., 2019).

3.2. Research Design

Due to the explorative nature of the research question, we used both qualitative and quantitative components (mixed methods) to aid the understanding of context and generate comprehensive insights, which were validated through triangulation.

A theoretical framework was derived from the literature examining linkages between nature connectedness, greenspace engagement, and citizen science to perform analysis for this research. As discussed in Section 2, the evidence in the literature (Lumber, Richardson & Sheffield, 2017; Martin et al., 2020; Richardson et al., 2020) has consistently emphasised the significance of having a close relationship with nature, i.e., nature connection in fostering pro-nature conservation behaviour in individuals, particularly when efforts are made to cultivate this attachment to nature in one's early years (Martin et al., 2020; Richardson et al., 2020). The qualitative work in this research primarily builds upon this research which documents the factors contributing to pro-conservation behaviour,

particularly the green care code (Richardson et al., 2020) and pathways to nature connection (Lumber, Richardson & Sheffield, 2017) (see Figure 1a,b).



(**a**) (**b**)

Figure 1. (**a**) 'Green care code' engagement matrix (after Richardson 2020); (**b**) categories of nature connection (Lumber 2017).

Amongst the factors contributing to pro-conservation behaviours, engagement with nature (which is related to nature connectedness) in everyday life is identified as most influential in inculcating environmentally responsible behaviours, and therefore, the likelihood of building environmental stewardship (Lumber, Richardson & Sheffield, 2017; Richardson et al., 2020). Active engagement with nature through simple activities centred around active restoration and conservation of the natural environment is identified to have a higher impact in comparison to direct but passive engagement with nature through simple activities such as bird watching or admiring the beauty of the natural environment. With respect to effectiveness in fostering nature connection, the type of relationship with nature or pathways to nature connection (Figure 1b) further influence the impact created by these activities, such that higher levels of nature connectedness are associated with engagement in pathway-informed nature-based activities (Lumber, Richardson & Sheffield, 2017; Richardson et al., 2020).

The two main indicators, 'Engagement with Greenspace' (based on type of activity) and 'Relationship with nature' (based on association with pathways to nature connection) are proposed to analyse nature connection and likelihood of pro-conservation behaviour. Therefore, we propose the following framework that defines a pathway to greenspace governance which integrates engagement and relationship to nature whilst recognising the role of barriers to participation (Figure 2).

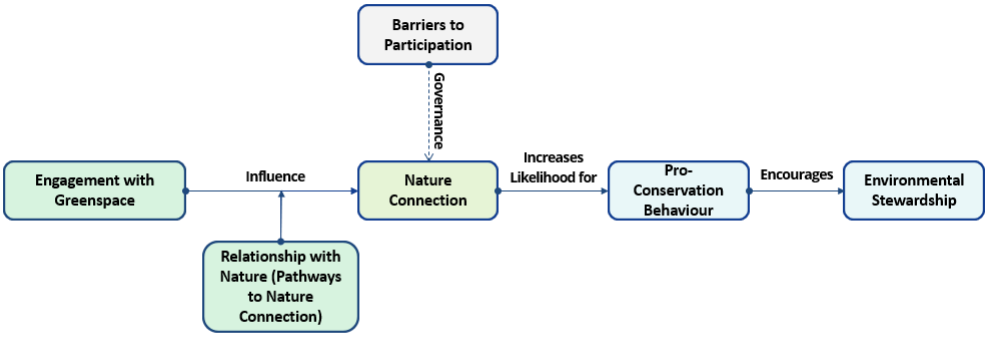


Figure 2. A framework for nature connectedness indicating pathways to environmental stewardship.

3.3. Research Process

The research is part of an EU-funded Urban Innovation Actions project entitled Green Minds, led by Plymouth City Council, which aims to create a planning and management system for sustainable land use and nature-based solutions (https://uia-initiative.eu/en/uia-cities/plymouth, accessed on 1/4/23). One of the aims of the project is to '*use scientific and creative digital tools to make nature in the city much more visible and exciting to people and develop these tools with stakeholders and communities ensuring they have the skills to be able to use them long term*' (https://greenmindsplymouth.com/projects/living-lab, accessed on 1/4/23).

3.3.1. The Nature Data Probe Toolkit

The project implemented a Living Lab approach with an open source IoT LoraWAN infrastructure installed in the Central Park and a series of engagement activities with local stakeholders. A Living Lab Nature Data Probe toolkit was developed prior to conducting this study, based on community consultations with park stakeholders and the theoretical framework derived from the literature. The components of the toolkit (Figure 3) were structured around creating simple nature-based activities (Richardson et al., 2020) to reveal hidden nature, create intentional greenspace engagement, and, in turn, create empathy for the natural environment. The toolkit consisted of the following:

- Custom-designed logbook with pages for entering observations and data;
- Blank Paper tags;
- Prototyping materials;
- QR codes to link to live data dashboard of data from the sensors;
- IoT Senstick environmental sensor (temperature, humidity, and pressure) *;
- IoT Senstick soil sensor;
- Pencils;
- Purpose-made plywood carry box;
- Large map of Central Park with Post-Its (for the mapping exercise).

* The MicroClimate SMC30 sensor and the Senstick Probe SSM30 uses LoraWAN technology to gather live data on air conditions and soil moisture, respectively, which were displayed on a dashboard interface accessed through a mobile phone using a QR code link (see Figure 4).

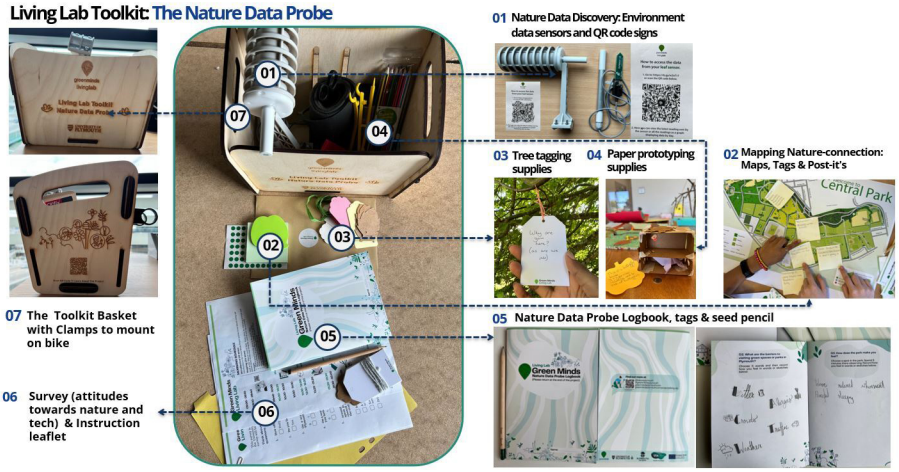


Figure 3. Components of the Living Lab Nature Data Probe toolkit.

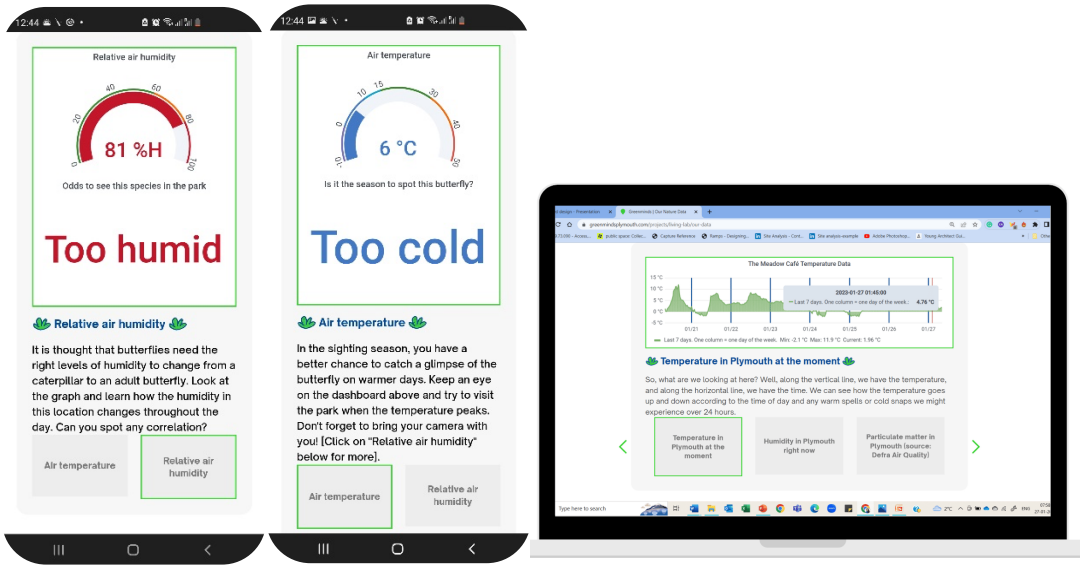


Figure 4. Data dashboard for environmental sensors (mobile and web interface).

3.3.2. The Context: Plymouth, UK

Plymouth is a waterfront city with more than 42% defined greenspace and is the biggest city in UK's south-western peninsula (PCC, 2010). Currently, half of Plymouth's greenspaces fall below the quality thresholds, along with being under-used and undervalued (LUC, 2017; PCC, 2010). In this context, the quality of the natural infrastructure in the city could continue to further decline, discouraging the people from using it while also simultaneously amplifying the reinstatement costs. These challenges around greenspace management and governance are common to other geographical areas. This research seeks to explore the application of the Living Lab approach in the project's pilot site in Central Park in Plymouth (Figure 5), the biggest park in the city and originally created in 1928 to improve city resident's health (PCC, 2008).

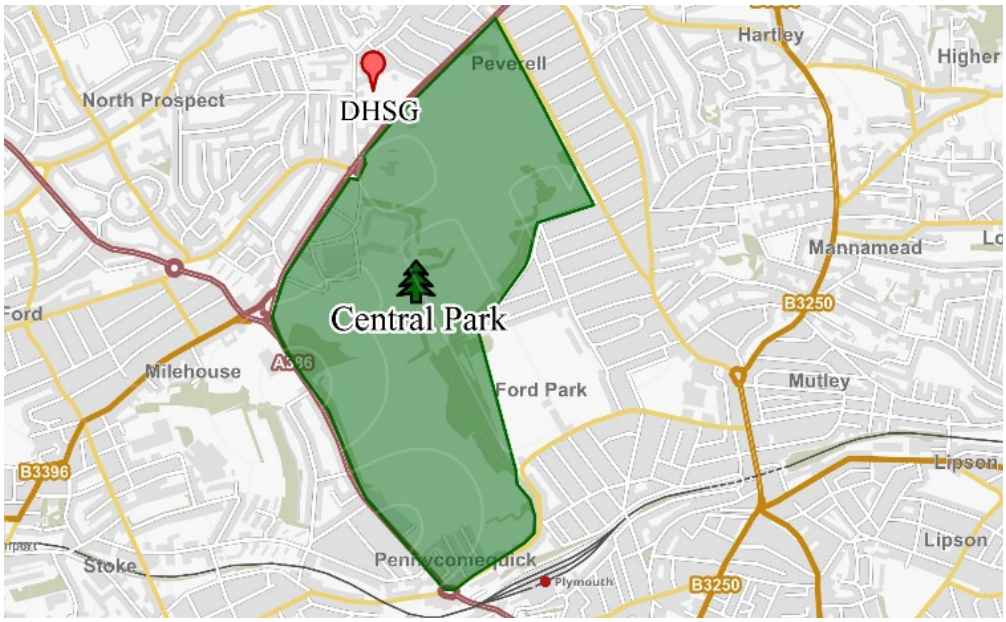


Figure 5. Location of DHSG in reference to Central Park, Plymouth.

3.3.3. Participants

We engaged with students from Devonport High School for Girls (DHSG), a large single-sex secondary school located adjacent to Central Park (Figure 5). The decision to recruit this stakeholder group for the purpose of this study was also critical to understand the challenges around the park's accessibility, as well as barriers to participation in its governance, as teenage children, particularly girls, are increasingly identified as one of the most-excluded groups in the urban design and planning processes (Holland, 2021).

The participants were recruited through their school which acted as a gate-keeping organisation to ensure the necessary safeguarding measures were in place. Informed parental consent was obtained prior to students' participation in the activity and all activities were delivered in school time under the supervision of staff. The entire year-eight cohort of 126 students aged between 12 and 13 participated in the workshop.

3.4. Data Collection

A pilot session initially was conducted with the school's sustainability club (consisting of 16 girls who were aged between 11 and 13 years) to trial the toolkit and familiarise the participants with the components of the toolkit. These volunteers later acted as the student ambassadors to help facilitate the delivery of the workshop to the wider cohort.

The data were collected using a mixed methods co-design workshop that took place over a full school day (9:00 a.m. to 3:00 p.m.) in July 2022 with 126 participants (all female) aged between 12 and 13, as described above.

The format of the day included an initial briefing session, completion of the baseline survey, and a mapping activity, which took place in the school hall, with the second half of the day taking place in the park. In Central Park, where the participants had the opportunity to interact and experiment with the Living Lab digital prototypes (installed in Central Park), they used the Nature Data Probe Toolkit to record live environmental data using sensors (Figure 6.).

Figure 6. Summary of workshop activities with the Living Lab Nature Data Probe toolkit.

At the start of the workshop there was a demonstration to inform the participants on the various components of the toolkit, including the different sensors, the data they collect, and how the participants could interact with these to see live nature data and discover more about their natural environment in the park.

Participants were then divided into sixteen groups of approximately seven participants each, with each group being given one Living Lab toolkit. The data collection was conducted as follows:

3.4.1. Baseline Survey

A survey containing a combination of open-ended and close-ended questions was formulated based on the theoretical framework (see Section 3) derived from the literature to gather a baseline evaluation of the participants' relationship with the nature pilot site, their general attitudes towards nature and greenspaces, and their perception of the use of technology for better greenspace engagement.

Figure 7. Participants in a group working on the mapping activity.

3.4.2. Mapping Exercise

The participants were given an A2-sized map of Central Park and a selection of coloured Post-Its, and qualitative data were gathered in response to open-ended prompts to gauge the participants' spatial awareness of the pilot site, their relationship with nature, their spatial relationship with the greenspaces in the park, and the usage patterns and barriers to engaging with these spaces. The responses were recorded in the form of rich qualitative data—texts and sketches by respective groups on Post-It notes and mapped in reference to different spaces on a map of Central Park (Figure 7). A deductive thematic coding (based on the theoretical framework) and further textual analysis were undertaken.

3.4.3. Qualitative Nature Data—The Nature Data Probe Logbook

The logbook was designed as a means to facilitate intentional engagement with nature amongst participants, using self-directed simple activities, and was adapted from the Cultural Probe method (Gaver, Dune & Pacenti, 1999). Each participant was provided with a Nature Data Probe logbook where a combination of open-ended prompts and tasks around reflecting and observing nature, along with tasks and close-ended questions around nature discovery using data, encouraged the participants to independently

engage with nature and record their experiences while in the natural environment. In this recording and reflective journaling process, responses were recorded in the form of text, anecdotes, sketches, and nature data observations (Figure 8).

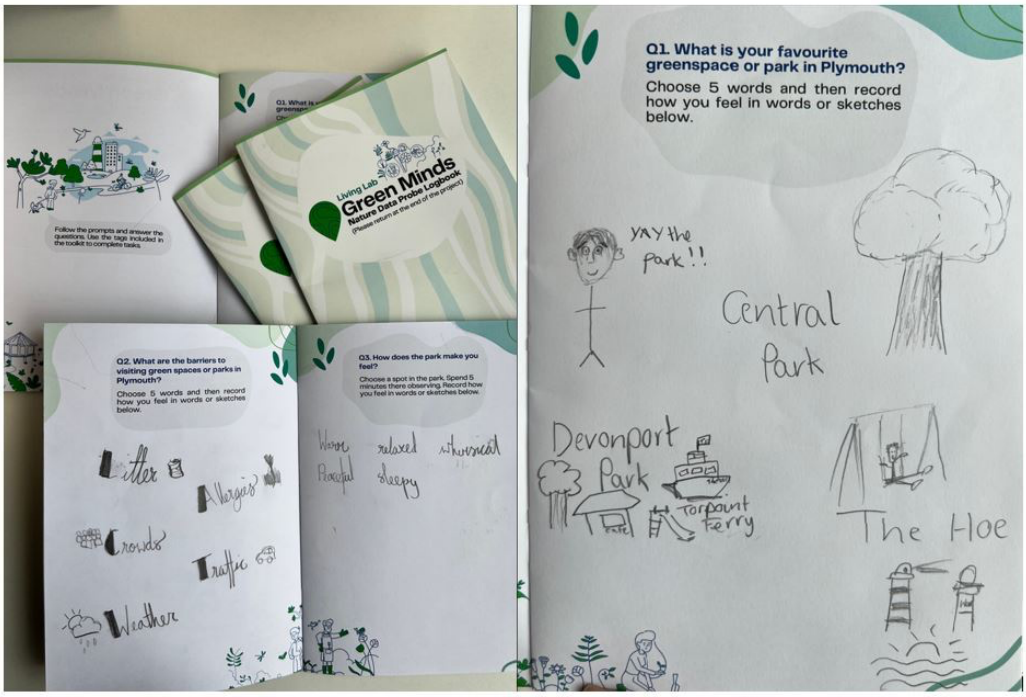


Figure 8. Sample page from logbook.

3.5. Limtiations of the Research

There are a number of limitations to the study, which may impact the results. The first is that we worked on a large group of female students from a secondary school, and thus did not include participants from a wider demographic. Although we do not analyse the impact of gender on the outcomes, we recognise that females and teenagers are often excluded from greenspaces because of issues of safety, and therefore experience some of the barriers to access we seek to address (NE, 2020). Secondly, we focused on one large urban park in Plymouth, although we did elicit more general data about perceptions and use of greenspace. We also gathered data using a primarily qualitative methodology and used a bespoke-designed Nature Data Probe toolkit. Therefore, the empirical method had a focus and engagement with a specific place and demographic, which may limit the scalability of the results, but also enabled us to gather detailed and insightful data about the subject of the study.

4. Results

4.1. Survey: Baseline Evaluation of Perceptions of Nature, Parks, and Technology

The baseline survey data suggest that while the participants recognise the wellbeing benefits of nature, they do not visit the greenspaces in the city enough, despite most being local to the city and having greenspaces in their physical proximity. The data also suggest that most participants reportedly feel connected to nature, find the greenspaces in the city accessible, and positively perceive the use of technology for potentially making them connect better to these spaces.

4.1.1. Baseline Survey on Greenspace Engagement and Attitudes towards Nature

In the baseline survey (see Section 3.4.1), only 19 students reported visiting greenspaces in the city daily, with more than half of the respondents (51%; n = 53) only accessing greenspaces a few times or less per month. Eighteen students reported never visiting greenspaces. In reference to the respondents' patterns of accessing greenspaces in everyday life (n = 104; (although there were 126 participants in total, some of the surveys were not returned), 67.3% (n = 70) of the students were reportedly based in Plymouth, and therefore had better access to the park (Figure 9).

When asked how important they felt connecting to nature was to their wellbeing, the respondents (n = 55) exhibited a positive association between nature connection and wellbeing (Figure 4). Approximately 90% (n = 49) of those who responded rated the importance of nature for their wellbeing at a score of 3 or above on a 0–5 Likert scale, such that with 43.6% (n = 24) of responses were at a score of 4, followed by 25.5% (n = 14) at score of 5 and 20% (n = 11) at score of 3. Only two respondents felt that connecting to nature did not improve their wellbeing.

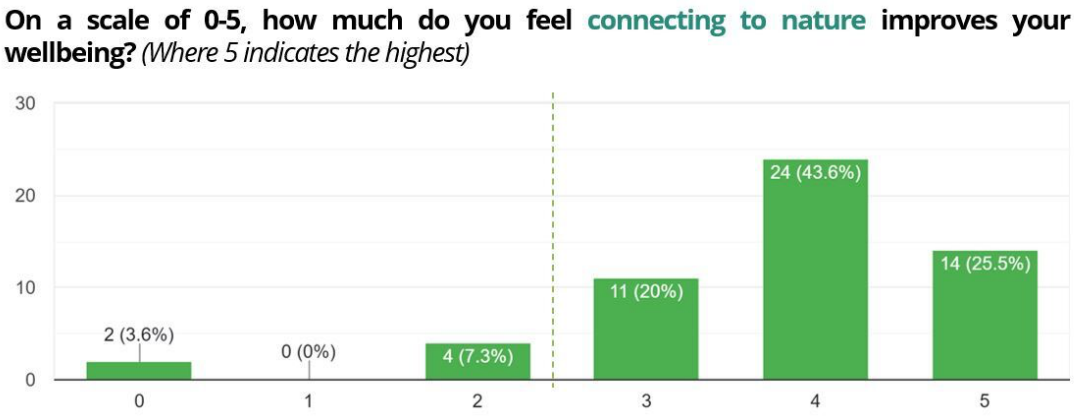


Figure 9. Survey responses to 'how much to you feel connecting to nature improves your wellbeing?'.

4.1.2. Nature Connectedness and Greenspace Accessibility

Positive perceptions of connectedness between self and the greenspaces (Figure 5) amongst the respondents (n = 55) were observed, wherein most students scored their feelings of connectedness with greenspaces/nature at a score of 3 (44%; (n = 24)), followed by 23% (n = 12) at the score of 4. Only about 9% (n = 5) of participants indicated low levels of connectedness with the greenspaces in their surroundings, at a score of 1 or below (Figure 10).

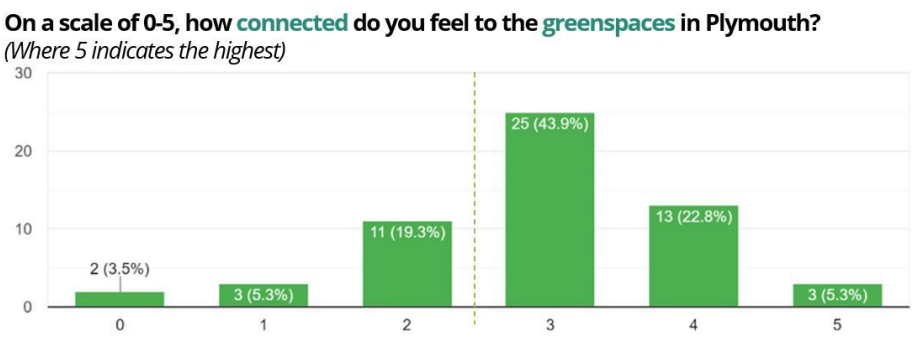


Figure 10. Survey responses to 'how connected do you feel to Greenspaces in Plymouth?'.

Relatively positive perceptions of the accessibility of greenspaces in the city were noted, where the highest number of responses (Figure 11) were recorded at a score of 3 (41.7%; (n = 43)), followed closely by a score of 4 (32%; (n = 18)). Only 5.8% (n = 3) of the participants reported to not find the greenspaces in the city adequately accessible, having responded with a score of 1 or less.

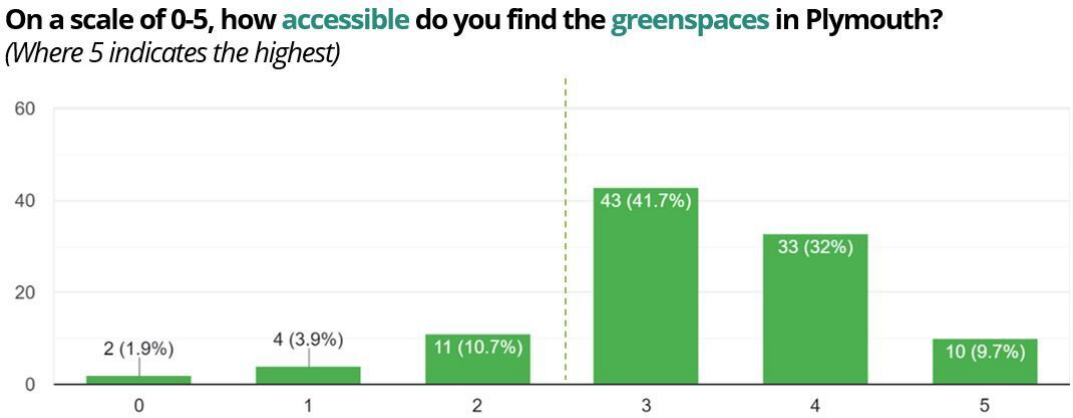


Figure 11. Survey responses to 'How accessible do you find greenspaces in Plymouth?'.

4.2. Mapping Spatial Relationships and Engagement with Nature in Central Park

A thematic analysis of the discourse (n = 389) recorded during the mapping activity (Figure 12) (see Section 3.4.2) based on the theoretical framework derived from the literature around nature connection in greenspaces gives insight into the participant's spatial relationship with the park and engagement with nature.

Figure 12. Mapping engagement and nature connection in the greenspace.

We analysed the findings according to our framework to understand engagement with greenspace, pathways to nature connection, and barriers to participation.

4.2.1. Engagement with Nature

We reviewed the responses to identify whether they referred to direct or indirect contact with nature. Amongst the descriptions of spatial preferences and activities engaged in (n = 166), an overwhelming number of responses made references to non-nature-based activities (Table 1).

Table 1. Mapping activity responses on nature engagement.

Engagement with Greenspace	Typical Response
Non-nature-based activities (n = 104)	'My favourite place in the park is Life Centre because there's a lot of activities and you can do sport' 'My favourite activities are playing football and playing the park while eating'
Indirect engagement with nature through indirect contact (n = 86)	'I like meeting up with my friends and walking my dog is fun here (in the park)'
Valuing nature for physical wellbeing (n = 22)	'I like running in the park'
Valuing nature for mental wellbeing (n = 3)	'I like walking through the trees because it clears my mind'

Of the 389 responses, only 2 referred to active engagement with nature in the park, with participants recording 'I like finding squirrels in the park' and 'My favourite place in the park are all the fields where you can see lots of different nature and wildlife'. The mapping exercise revealed that participants typically only engage with greenspace on a superficial level and that they primarily undertake non-nature-based activities or are only exposed to indirect contact with nature (where nature becomes a background for everyday activities such as walking and socialising).

4.2.2. Pathways to Nature Connection

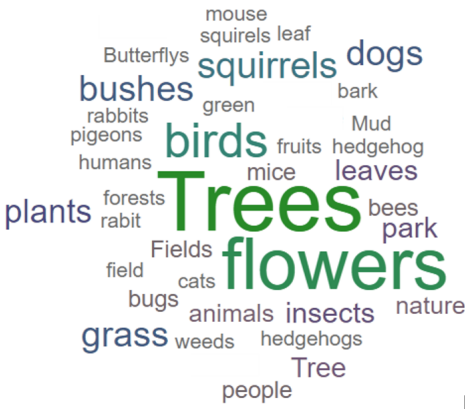
Using the categories of 'relationship with nature' defined by Lumber et al. (2017), we analysed the 54 responses that made some reference to nature connectedness from the mapping exercise (Section 3.4.2). We analysed the categories of nature connection: sensory contact, emotion, beauty, meaning, and compassion (Lumber, Richardson & Sheffield, 2017). Of these, most (n = 22) were made regarding connecting to nature through appreciation for its beauty, such as *'My favourite place in Central Park is Mawson's fields because I love all of the flower bushes that grow there in the tree'*. Seventeen references were made to nature connection due to sensory stimulation or emotion, such as '*The trees are nice because they help me clear my mind…*' A connection to nature due to compassion for nature or knowledge of the environment was referred to nine times in the responses: '*The trees and plants photosynthesize for us*'. Only seven references were made to nature connectedness due to experiences or meaning associated with the space—'*My favourite place is the Reservoir field because me and my sister go there when it's sunny*'. The responses showed that connection to nature is primarily derived by the aesthetic aspect of the environment and sensory stimulation.

4.2.3. 'What Nature Do you See in the Park?'

The participants responded to the question 'what nature do you see in the park?' using Post-It notes on the map of Central Park in the form of text and sketches. A total of 240 references identifying different elements of nature were made in the responses recorded during the exercise. The analysis of the discourse reveals the use of a predominantly generic vocabulary to describe nature in the park, such as *'In the park there are lots of flowers and trees'*, *'There are also lots of animals'*, and *'I see dogs, insects, and lots of plants.'*

Overall, the results of the content analysis reveal that the majority (n = 209) of the 240 different references to nature identified nature in vague or generic terms (see Figure 13).

Words such as 'trees' (n = 51), 'flowers' (n = 39), 'birds' (n = 26), 'grass' (n = 17), 'bugs/insects' (n = 15), 'plants' (n = 11), and 'animals' (n = 7) were used. Amongst the more descriptive responses, only 19 references were made to native fauna in the park, with the following all receiving less than 6 responses: 'bees', 'butterflies/butterfly', 'pigeons', 'rats/mice/mouse', and 'squirrels/squirrel'. None of the responses specifically identified any native flora in the park.



Type of Nature Identified	Number of Mentions
Native Flora in the Park	0
Native Fauna in the Park	19
Generic Responses	221

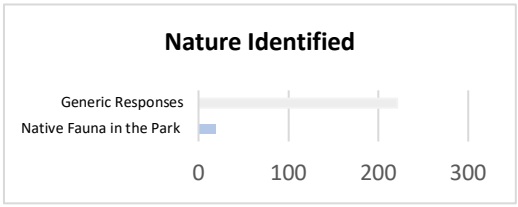


Figure 13. Word cloud (number of mentions of nature identified in 81 Post-It note responses, green font- native flora, blue font- native fauna, purple font- generic response).

The baseline qualitative data suggest that the participants hold a superficial level awareness of biodiversity around them in the park and describe nature around them using generic vocabulary.

4.2.4. Barriers and Challenges to Accessing Greenspaces

In order to understand the barriers to greenspace governance, we asked the participants to identify the challenges experienced while accessing the park. The participants' least-favourite spaces centred around perceptions of safety and poor maintenance, as well as anti-social behaviour (Table 2).

Table 2. Responses from mapping activity on barriers to accessing greenspaces.

Category	Example Response
Park maintenance (n = 55)	'Litter is bad, litter is really really bad',
Perception or memory of the space (n = 13)	'I don't go to the park because it smells like drugs'
Safety (n = 14)	'Poorly lit areas, weird people, broken equipment, vandalism, sketchy places'
References to people and their general behaviour in the park (n = 14)	'People don't pick up after their dogs'
Outliers (n = 38)	'It's very boring, there's nothing to do'

The responses show that the main challenges around greenspace management and safety are perceived as primary barriers to using greenspaces more often.

4.3. Developing Nature Connection—Nature Data Probe

4.3.1. Nature Data Probe Logbook—Reflective Journaling in the Park

Following the first half of the session in the school, all the participants walked to the park for the second half of the workshop (Figure 14). Working in their groups, the participants had approximately an hour in a field in Central Park to use the logbooks to record the nature around them and to reflect on what they were observing..

Figure 14. Logbook activity in central park.

The Nature Data Probe toolkit gave the participants the opportunity to use citizen science technology to see and build narratives around live nature data in the park and record observations.

4.3.2. 'What Nature Do You See in the Park?'

Using the Nature Data Probe logbook, participants were asked to spend 5 min observing nature and reflecting on 'what nature do you see?', recording their responses in the form of text and sketches (Figure 15).

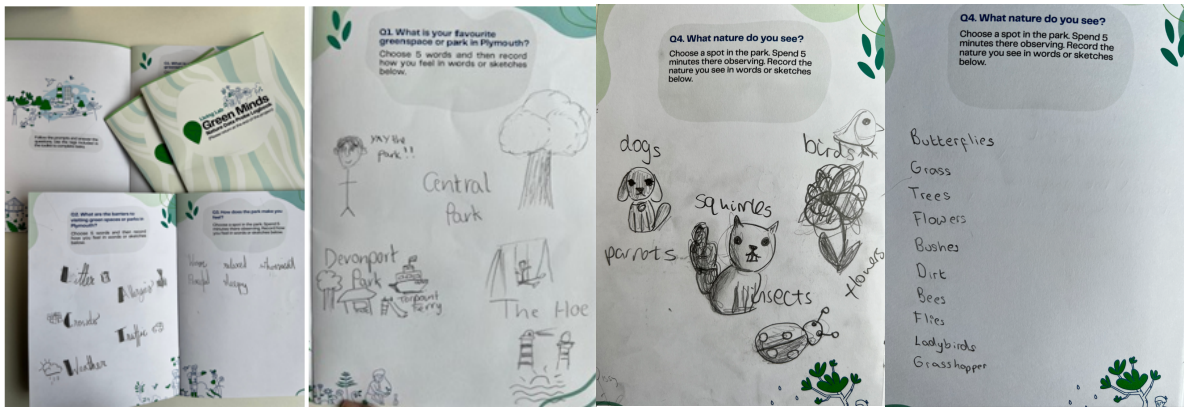


Figure 15. Nature Data Probe logbook: some responses.

A total of 411 different references identifying nature were recorded in 126 logbooks. Amongst the responses recorded, 315 references to nature used generic vocabulary in their descriptions, such as 'trees' (n = 79), 'grass' (n = 64), leaves (n = 30), 'flowers' (n = 25), 'birds' (n = 17), and 'bushes' (n = 12), while 95 references to nature in the responses used a descriptive vocabulary to identify nature in the park. Amongst these, 33 references to native flora in the park were made such as 'stinging nettles/nettles' (n = 7), 'Thistles' (n = 4), 'Oak' (n = 3), 'Ivy' (n = 3), and 'Elderflower' (n = 2). A total of 64 descriptive references to fauna

in the park were made, including butterflies (n = 25), 'bumble bee/bees' (n = 10), 'flies' (n = 10), 'ticks' (n = 5), 'spiders' (n = 5), squirrels (n = 3), and 'grasshopper' (n = 2), with some less-commonly observed species such as 'magpie' (n = 1), wasps (n = 2), and ladybird (n = 2) also identified in a few responses (Figure 16).

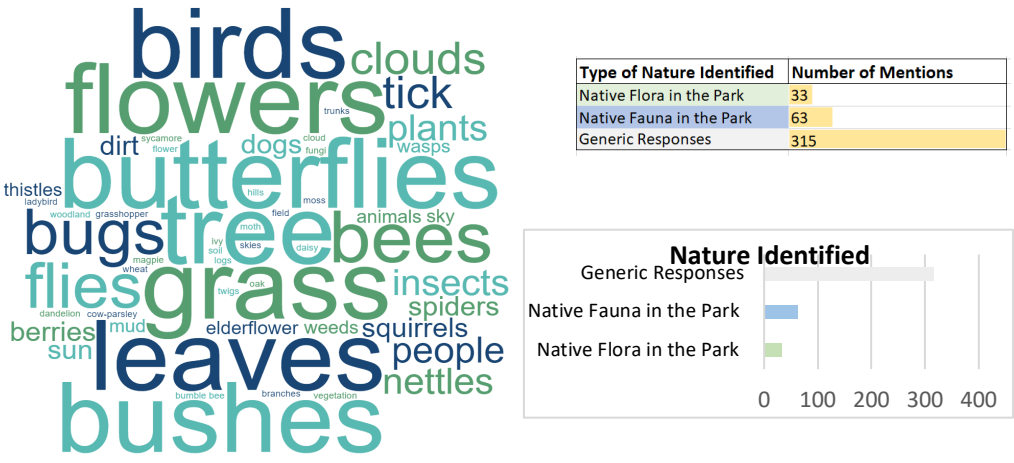


Figure 16. Word cloud (nature identified in the Nature Data Probe logbooks—number of mentions,, green font- native flora, blue font- native fauna, purple font- generic response).

The analysis of logbook responses shows use of more descriptive and specific vocabulary and indicates that it enabled hidden nature to be revealed.

5. Discussion

5.1. Nature Connection and Greenspace Engagement

The mixed methods approach offered insights into the participants' spatial relationship with greenspaces, engagement with greenspaces/nature in parks, attitudes towards nature, and perception of the use of technology to create engagement. These findings were consistent across the pilot and the main studies. We found that there was a disparity between the self-reported levels of nature connectedness and the actual presence of the stakeholder group in the park.

A quantitative analysis of the self-reported feelings of connectedness with nature, as recorded by the semi-structured survey, reveals positive associations between natural environments and the individual, where most participants rated their connection to nature at 3 or above on a scale of 0 to 5. Similarly, a positive perception of the significance of nature for personal wellbeing—both physical and mental—is observed, wherein most participants scored the significance for nature for their wellbeing at 3 or above. These positive perceptions of nature, however, did not result in more visits to the parks. While most of the research participants reported living in Plymouth, more than half of the participants reportedly accessed the city's greenspaces a few times a month or less. This gap in the participant's physical presence in the greenspace, despite recognition of the wellbeing benefits and reported positive perceptions around accessibility and connectedness, indicate a need to improve public engagement with the city's parks.

The participants' responses to open-ended prompts structured around spatial usage, activity patterns, spatial preferences, awareness of and engagement with nature, and barriers to accessibility revealed that the majority of participants reportedly engaged in non-nature-based activities in the park, with responses (58) such as *My favourite place in the park is the Life Centre because you do lots of sports that you like*'. This was followed by the references to indirect engagement/indirect contact with nature, with responses (44) such as '*Meeting up with my friends and walking my dog is fun here*'. Direct engagement with nature was substantially (17) lower and primarily through passive (15) means, such as enjoying the

beauty of nature, e.g., '*I like seeing all the trees and blossomed flowers'*. Only two responses made a reference to activities around enjoyment in nature discovery, while no mentions of active efforts to restore or look after nature in the park were recorded. This emphasises the lack of a sense of ownership towards the environment and the need to improve greenspace engagement to, in turn, facilitate better greenspace management.

A subsequent analysis of the thematic category of data describing barriers to accessing greenspaces and negative spatial perceptions as reported by the participants further highlights the factors contributing to this contrast in the relatively positive perceptions of nature with the lack of actual physical presence in the park, as observed, in particular, in the context of this stakeholder group, i.e., young teenage girls. Their responses revealed substantial barriers linked to governance (referring to maintenance and infrastructural aspects) and safety. Similarly, outliers documenting the negative attributes of the space, such as '*I hate brambles*' and '*there's nothing to do*', and bad memories or perception of space, also emerged as factors contributing to the lack of a sense of belonging and the feeling of ownership towards the park. These findings emphasise the need to improve participation and explore inclusive co-stewardship-based governance models for greenspaces to alleviate these barriers to accessibility and public engagement, particularly for groups traditionally underrepresented in participation processes, as in the case of this study.

5.2. Revealing Hidden Nature: Engagement in Greenspace and Citizen Science

In the school-based survey and mapping activity, we found that most participants only had a superficial level of engagement with the natural environment. While self-reported levels of nature connectedness and valuing nature for wellbeing were recorded towards the higher end of the spectrum, the connection with nature as observed from a qualitative thematic analysis in reference to the pathways to nature connectedness reveals a contrast. Here, the all-qualitative responses recorded in the mapping activity were analysed in reference to four sub-thematic areas forming the different pathways to nature connectedness (Lumber, Richardson & Sheffield, 2017; Richardson et al., 2020), namely, through senses/emotion, beauty, meaning/experience, and compassion/knowledge. Results indicate that nature connection is primarily experienced in terms of the aesthetic component of the natural environment amongst the majority of the participants. The other dominant component for experiencing nature connection was through the senses, while virtually no mention of nature connection created through compassion or knowledge for the environment was recorded in the responses. This is consistent with the results documenting greenspace engagement, wherein most participants reportedly engaged in non-nature-based activities in the park and the only engagement with nature was through passive means, where nature became the backdrop to everyday activities.

The responses make almost no references to active efforts towards conservation of the environment, governance, or use of nature data to learn about and care for the environment. This suggests that active engagement is needed to build nature connectedness, and the literature shows that this can be achieved through simple nature-based activities for engagement to translate into meaningful stewardship (Jordan et al., 2018; Richardson et al., 2020).

Revealing Hidden Nature as a Pathway to Greenspace Governance

To determine the potential of the Living Lab Nature Data Toolkit in creating meaningful engagement, a comparative analysis of the qualitative data around awareness/consciousness of the natural environment gathered prior- (mapping) and post-intervention (logbook) provided useful insight. The mapping activity (prior intervention) revealed the use of generic vocabulary to describe the natural environment, such as '*I see trees, bushes and wildlife*'. These findings highlight the 'invisibility of nature' in everyday life (Richardson et al., 2020). In contrast, the responses documented in reflective journaling conducted after engaging with the Living Lab toolkit record more nuanced and variegated

descriptions of nature in the park, including an increase in the number of participants and in the specific and descriptive responses identifying nature for both flora and fauna in the park. These findings indicate that a deeper awareness of the natural environment was created as an outcome of this intervention, suggesting that hidden nature was revealed. This aligns with research that emphasises the need to restore human–nature connections by 'affording the possibility of meaningful interaction with nature in close proximity to the places where people live and work' ((Miller, 2005), p. 434).

6. Conclusions

In this research, we build on previous work around citizen science and community engagement, but from a place-focused perspective. We draw on previous work that showed the potential of such place-based citizen science projects, such as Living Labs, for improving human–nature connections and, in turn, facilitating greenspace governance. In the context of urban greenspaces, Living Labs can not only inform the participants about the effective ongoing management of greenspaces, but also increase their capacity for long-term monitoring and subsequent nature stewardship (Jordan et al., 2018). Therefore, in our study, our research question was to test 'whether we could develop a Living Lab toolkit to facilitate a sense of nature connectedness to address challenges of participation in the governance of green spaces?'.

In the literature review we highlighted how greenspace practices are conventionally state-dominated, particularly in UK, where, as a landowner and/or manager, the local authority is responsible for looking after these spaces, with national and local taxation being the primary sources of funding (Mathers, Dempsey & Molin, 2015). The potential significance of innovative governance arrangements for fostering inclusive development processes are increasingly being recognised (Swyngedouw, 2005). With their focus on increasing participation, these new arrangements of governance can create greater inclusiveness and challenge the traditional state-centred policymaking by generating new forms of 'governance-beyond-the-state' (Geddes, 2006; Swyngedouw, 2005). In our study we found that active engagement is needed to build nature connectedness and this can be achieved through simple nature-based activities for engagement to translate into meaningful stewardship (Jordan et al., 2018; Richardson et al., 2020). If a Living Lab approach is used to transform passive engagement into the 'place-keeping' of urban greenspaces, it can democratise the state–civil society relationship by enabling new ways of participation and can, therefore, be a pathway to co-stewardship-based greenspace governance.

A place-focused approach to citizen science in this regard can not only create literacy around digital sensing tools and making data accessible, but also empower citizens by creating a deeper awareness of nature in urban greenspaces. This is particularly relevant from the standpoint of capacity building in more deprived communities. The community can make well-informed decisions using the evidence base generated during iterative cycles of data collection. Participation in such projects can thus enable the citizenry to identify and drive intervention, and, therefore, empower them to better look after these greenspaces. This is a shift from the traditional 'top-down micro-management to a flexible and locally responsive approach' (Mathers, Dempsey & Molin, 2015). Further, the increasingly restricted public funding for management of complex and dynamic challenges around greenspace governance in cities calls for a wider stakeholder partnership between the public and private sectors and the local community. We suggest that, within this policy context, the Living Lab as a multi-stakeholder approach can be an opportunity for better cross-sector partnerships by bringing a wider set of stakeholders to not just engage in citizen science, but also actively care for urban greenspaces and, in turn, generate the social capital for collective action towards long-term change.

We found that stakeholder mapping, by enabling the participants to engage and identify the potential barriers to engagement, can make these projects accessible, particularly for hard-to-reach groups. Engaging a younger audience, such as the school-age children in our study, can be particularly effective in establishing a long-term and sustained

stewardship of the natural environment by giving them the tools and know how to care for their local greenspaces. In this context, Living Labs can be an innovative pathway towards creating a more participatory and inclusive greenspace, and may have positive spill-over effects in engaging and connecting people with their local parks and greenspaces.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: We encourage all authors of articles published in MDPI journals to share their research data. In this section, please provide details regarding where data supporting reported results can be found, including links to publicly archived datasets analyzed or generated during the study. Where no new data were created, or where data is unavailable due to privacy or ethical restrictions, a statement is still required. Suggested Data Availability Statements are available in section "MDPI Research Data Policies" at https://www.mdpi.com/ethics.

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