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# **The Influence of Organisational Settings on Large Environmental Citizen Science Projects**

—— A Case Study of OPAL

**Bin Guan**

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MSc *European Spatial Planning & Environment Policy* | Cardiff University

MSc *Environment & Society Studies* | Radboud University

Supervised by

**Dr. Andrew P. Kythreotis** | Cardiff University

**Dr. Mark A. Wiering** | Radboud University

Supported by

**Dr. Ria Dunkley** | Sustainable Places Research Institute



**Radboud University**



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## **Abstract**

In the past decade, citizen science has experienced a significant development in both scope and scale. Especially in environmental monitoring, where massive data collection is required, citizen science has been increasingly adopted by various organisations. For citizen science projects running at different geographic scales, different organisational settings are usually required, which might in turn affect the operation of the projects. Such influence is more significant on large-scale citizen science projects. Thus, it is interesting to look into the organisational settings of citizen science at a large scale, and examine how they influence a project in practice.

Based on a case study of one of the largest citizen science projects in the UK, the research looks into the organisational settings and the regional operation of OPAL. By gathering insights from different stakeholder groups and participating in two engagement events, several issues were discovered from the study: firstly, the operation of OPAL relies largely on the community scientists and the informal network; secondly, the contradiction between the outreach target and the limited staffing leads to relatively low-level engagement; thirdly, low-level participation could also bring about social benefits and lead to positive attitude; finally, the current state of OPAL is not very sustainable due to the funding, staffing and engagement issues, but its members are trying to sustain it in different ways. Regarding all these issues, it is worth rethinking about the balance between the quantity and quality of participation, as well as how to sustain such projects with limited resources.

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# **1. Introduction**

## **1.1 Research Context**

Due to the changing scientific paradigms and the growing involvement of amateurs in data collection beyond geographic limits, ‘Citizen Science’, broadly known as public participation in scientific research, has experienced considerable expansion in practice and is receiving growing attention in a wide range of areas in the recent decade. This trend is most remarkable in the environmental domain, where “citizen engagement has long been recognized in the environmental science and policy literature as a tool for collecting data, advocating for social change and environmental justice, making science more inclusive, and enhancing social-ecological connections” (Johnson et al., 2014, p.236).

In the field of environmental monitoring, where massive repetitive data collection is required, the ever-growing demand for public contribution has brought citizen science to the fore. However, not all the public participation practices in environmental monitoring could be considered as citizen science. To clarify this, the UK Environmental Observation Framework recommended a valuable way to describe citizen science in environmental monitoring, namely “volunteer collection of biodiversity and environmental information which contributes to expanding our knowledge of the natural environment, including biological monitoring and the collection or interpretation of environmental observations” (Roy et al., 2012, p.10).

As a new mode of scientific research, citizen science could be conducted by a variety of organisations, including governmental bodies, NGOs, charities, corporations, partnerships, cooperatives, research institutes, or even grassroots groups. According to Haklay (2015), different types of organisational structures are suitable for delivering citizen science activities at different geographic scales. For citizen science activities conducted at a small to medium geographic scale, an independent group of people or organisation might be able to run them well. But for a citizen science project running at a larger geographic scale, a lot



of teamwork and extensive collaboration are usually needed, which will require a more comprehensive organisational network with collaboration from a variety of partners.

As an intermediate platform for coordinating resources and different stakeholder groups, organisations play significant roles in different aspects of citizen science. Their roles could be seen through the whole project lifecycle, such as project initiation, collaboration, facilitating participation, and project maintenance. With different organisational settings, there might be different influence on all these aspects of a citizen science project. Especially for citizen science projects running on a large geographic scale, the influence of organisational settings tend to be more evident.

## **1.2 Research Problem and Objectives**

The flourishing of citizen science cannot sustain without the support and promotion from organisations. However, while the current academic focus frequently concentrates on the role of public participants in citizen science, there is still a lack of focus on studying the organisations in citizen science, especially how the organisational settings would influence a project's operation. This issue is particularly important for citizen science projects running on a large geographic scale. As such projects tend to have more complex organisational settings, the potential influence on the project operation would be more significant, which might affect the effectiveness of the citizen science project from different aspects.

Therefore, it is necessary to study the organisational settings of citizen science and their potential influence on the citizen science practices. With a specific focus on environmental monitoring in the UK, this study will examine the organisational settings of a large-scale citizen science project, and explore their potential influence on different aspects of the project in practice. Through this study, the research aims to contribute a new perspective to the current citizen science literatures, and provide some valuable insights into promoting more effective and sustainable operation and collaboration in large-scale citizen science projects.

### **1.3 Research Questions**

To examine the organisational settings of a large-scale citizen science project and how they influence the operation of the project, the research distinguished four research questions:

**1) *What is the state of governance and collaboration in the citizen science project?***

This question aims at examine the organisational settings of a large-scale citizen science project by looking into its governance system and collaboration forms. Before the analysis, the study will first review relevant literatures on this two aspects that are related to citizen science. The key elements generated from the literature will then be applied to the study case in addressing the research question.

**2) *How do partner organisations recruit participants and facilitate participation?***

This question aims at examining how different partner organisations of a large-scale citizen science project recruit public participants and facilitate participation in the citizen science activities, and how these approaches are influenced by the organisational settings of the project.

**3) *To what extent are participants engaged in and influenced by the citizen science activities?***

This question aims at examining the extent to which public participants are engaged in a large-scale citizen science project, the potential influence on participants from participation, and how these aspects are affected by the project's organisational settings.

**4) *How sustainable is the citizen science project?***

This question aims at examining the sustainability of a large-scale citizen science project and how it is affected by the organisation settings of the project.

## **1.4 Structure**

Following the introduction, this research will start with reviewing existing literature relevant to the research topic. The subheading and content of this section is structured mainly according to the four research questions that focus on different aspects of citizen science. At the end of this part, a conceptual framework will be developed from the literature review, which serves as the basis of the research. After the literature review, it then moves on to the methodology of the research. This section will outline the whole research design and the different methods being used to address the research questions, as well as the ethical considerations of the methods. The subsequent analysis part will be the core section of this research. In this section, data collected from different approaches will be categorised and analysed according to the four main aspects of the research topics, thus to address correspondent research questions. After the analysis, it then come to the final conclusion. In the final part, research findings will be summarised to examine how the four research questions have been addressed. Based on this, recommendations will be drawn to guide future citizen science practices. At the end, limitations of the research will be summarised, and areas for further research will be explored.

## **2. Literature Review**

### **2.1 Citizen Science and Organisations**

#### **2.1.1 Citizen science and its adoption in environmental monitoring**

The notion of Citizen Science has long been used in defining a wide set of activities which connect the general public with scientific research. In terms of its definition, the newest version comes from America's *Crowdsourcing and Citizen Science Act of 2015*, which defines it as "a form of open collaboration in which individuals or organisations participate in the scientific process in various ways" (the Senate of the United State, 2015, p.5). Though citizen science is usually regarded as an emerging phenomenon, its origin could date back to the 19th century and even earlier, when most scientific research was undertaken by amateurs out of inherent interest. According to Silvertown (2009), what actually distinguishes modern citizen science from its precursor is that it has been changed from a minority privileged game to an activity that is potentially available to all. The past decades has witnessed a dramatic growth in the number of modern citizen science projects and their scale, and the focus on citizen science has gradually transformed from the traditional "scientists using citizens as data collectors" to "citizens as scientists" (Lakshminarayanan, 2007). Under such context, citizen science in modern days could be looked upon as "representing a return to a centuries-old approach to doing science, and to challenge the notion that science must be done by 'experts'" (EC, 2013, p.5).

In the field of environmental monitoring, policy-makers and non-governmental organisations around the world have increasingly used citizen science to assist them in monitoring and managing natural resources, track endangered species, and conserve protection zones (Conrad & Hilchey, 2011). There are several reasons behind this trend. Firstly, environmental monitoring involves massive repetitive measurements to detect environmental changes over time, which are usually time and labour consuming, especially when they need to be done within a large geographic scale. Secondly, environmental

monitoring system also includes environmental decision-making (Gouveia & Fonseca, 2008). As early as 1998, the Aarhus Convention of the EU underlined the significance of public participation in environmental decision-making and access to justice in environmental matters. Thirdly, the increasing adoption of citizen science in environmental monitoring is also attributed to the development of the new information technology, as well as the increase in public knowledge and concern about environmental issues. However, Pocock et al. (2014) argued that citizen science might not be the optimal approach for environmental monitoring. Instead, he proposed that when funding is sufficient, it would be better to maintain professional monitoring and engage the public with the remaining resources. This opinion reflects a concern about the risk of excessively downgrading the role of professional scientists and over-exaggerating what citizen science could achieve in environmental monitoring.

### **2.1.2 Organisations of citizen science**

Though the term ‘organisation’ could be used in many different ways, one of its most general definitions is “a group of people who work together in an organised way for a shared purpose” (Cambridge Dictionaries Online, 2015). In general, it refers to an entity comprising multiple people, such as a government body, NGO, charity, partnership, cooperative, research institute, or even grassroots group. In the context of citizen science, as scientific activities are undertaken in a form of open collaboration between the general public and scientific groups, they have to be organised by members of the public, scientific groups, a third party agency, or a combination of them. Such a group of people who organised citizen science activities together for a common purpose could be regarded as a citizen science organisation.

According to Haklay (2015), citizen science activities at different geographic levels require different organisational structures, which influences how people can participate, and the longevity, scope and scale of the project activities. He stated that when environmental concerns are within limited local scale over a short period of time, an ad hoc organisation structure- often a small group of committed individuals- could run a citizen science project

well. Because in such a neighbourhood-scale organisation, as people are familiar with each other, it is possible to maintain a continuous local interest and participation over time. When the geographical scale and time span increase, he suggested that a formal organisation structure- small to medium sized NGOs- are more suitable for managing citizen science activities and providing necessary support. He further explained that such light organisational structures tend to “have the benefit of dedicated effort for coordination and management, as well as ensuring that training for participants is similar across different sites” (Haklay, 2015, p.41).

However, apart from the above two types of organisational structure, Haklay did not elaborate on the more complex organisational settings of a larger scale (national or international) citizen science project that could hardly be conducted by a single organisation. But he pointed out that “cooperation between organizations is a common characteristic of citizen science activities, especially at the larger geographical scales” (Haklay, 2015, p.41). In terms citizen science projects of larger geographical scale, a cooperation network or partnership, namely the collaboration among governmental bodies, NGOs, communities and universities is usually needed for addressing wider environmental issues. Thus, this research aims at exploring the organisational settings of a large-scale citizen science project in environmental monitoring and evaluate how it fits the citizen science approach.

## **2.2 Governance and Collaboration in Citizen Science**

As a large-scale citizen science project might involve various partner organisations and a wide range of stakeholders, its organisational settings tend to be more complex than citizen science project running at a smaller scale. To understand the organisational settings of a large-scale citizen science project, it is necessary to look into its governance structure and collaboration form. In this section, two important concepts- network governance and scientific collaboration are introduced.

### **2.2.1 Network governance**

In terms of governance, the most commonly associated mode is ‘network governance’ (Jones et al., 1997), which is also known as ‘organisation network’ (Miles & Snow, 1986). In general, it refers to “interfirm coordination that is characterized by organic or informal social system” (Jones et al., 1997, p.913), in which autonomous stakeholders work together to reach common objectives. Though network governance is originally used in economic activities, due to the state’s failures to govern complex environmental issues, it has been increasingly used as a new mode of governance in the environmental domain. As an open form of collaboration, citizen science, especially a large-scale environmental monitoring projects that involve a non-hierarchical network of organisations, could be regarded as a network governance system. According to Robins et al. (2011), the preconditions for an effective network governance system include: (1) network structures that could facilitate coordinating actions, promoting the cultivation of trust and team-like cooperation; (2) extensive agreement on objectives and actions among stakeholders of the network; and (3) concrete objectives and actions that are sufficient to achieve the wider objective of the network system. The following paragraph will elaborate on these preconditions.

In terms of network structures, both formal and informal structures are important for effective network governance, because its networks intend to offer organisational direction and coherence to a wide range of actors (Robins et al., 2011) While formal structures refer to the prescriptive organizational framework of roles and procedures, informal structures usually develop from the interaction processes (Ranson et al. 1980). As Robins et al. (2011) suggested, “If... a decentralized but networked system is intended to operate, informal networks can take on a role of enhanced importance” (p.1296). In regard to extensive agreement, to facilitate effective collaboration within the network, both relational and structural embeddedness are important. Specifically, relational embeddedness indicates that “dyadic partners consider one another’s needs and goals”, while structural embeddedness refers to “members of a dyad shared partners and those partners were themselves connected

to one another” (Robins et al., 2011, p.1297). As for specific goals and actions, macroculture - “a system of widely shared assumptions and values... that guides action and create typical behaviour patterns” (Jones et al., 1997, p.929) - is another significant factor for effective network governance. According to Robins et al. (2011), without having a strong macroculture, each single entity of the network will try to achieve their own objective at the expense of their counterparts, thus create more conflict or contestation within the governance system.

For an effective citizen science project running on a large scale, all these elements- formal and informal structures, relational and structural embeddedness, and macroculture- should be evident in its governance system. Thus, this study looks into all these aspects in the study case when examining the effectiveness of its governance system.

### **2.2.2 Scientific collaboration**

According to Finholt & Olson (1997), “science is an inherently collaborative enterprise” (p.5). In the past few decades, scientific collaboration has continued to increase and is gaining more and more importance. As a new model of science, citizen science contains one of the main attributes of science: collaboration. In regard to scientific collaboration, citizen science involves collaboration among scientists and other professional groups, as well as collaboration between scientists and the general public.

In terms of collaboration among scientists and other professional groups, Sonnenwald (2007) gave a comprehensive overview over the extant research on scientific collaboration, and classified them into three groups, namely the disciplinary focus, geographical focus, organisational and community focus. In regard to the disciplinary focus, it refer to an increasingly common research method which could generate new knowledge through integrating extant knowledge from different academic domains. In regard to the geographic focus, it refers to remote scientific collaboration that enables scientific research across geographic boundaries. As for the organisational focus, it refers to cross-organisational



collaboration between scientists from universities and scientists or professionals from industries. In terms of collaboration between professional scientists and the general public, which is categorised under the community focus by Sonnenwald's (2007) classification, it refers to a new type of scientific collaboration whose objectives is to create new knowledge that could bring about effective social action to solve real-life issues (Sonnenwald, 2007). In such collaboration, Participants play a significant role as they determine the effectiveness of the social action. Compared to the scientific collaboration among scientists and other professionals which used to be dominant, the scientific collaboration between scientists and the public is gaining increasing significant.

As a new scientific research model, citizen science is distinguished from traditional science by its key attribute- the collaboration between professional scientists and the general public. Apart from this new collaboration form, citizen science is also becoming more and more collaborative across different disciplines, geographic scales, and organisational boundaries. Therefore, all the above scientific collaboration forms could be seen in citizen science. As different types of scientific collaboration would require different organisational settings, there might be different influence on the operation of citizen science projects. Thus, this research looks into different types of scientific collaboration when examining the organisational settings of a large-scale citizen science project. Through taking into account both the state of governance and collaboration, a more complete picture of the project's organisational settings could be developed from the study.

## **2.3 Recruitment of Participants and Facilitation of Participation**

### **2.3.1 Recruiting participants**

Before public involvement could happen in citizen science, a significant issue for the organisation is to recruit participants, which could be either an easy task or a challenging job. According to Bonney et al. (2009), for citizen science projects targeting the general public, a wide range of approaches could be used to recruit participants, which include press

released, publications, public service announcements, posters, fliers, direct mailings, presentations, workshops and conferences. But for projects targeting specific audience groups, they suggested that apart from developing suitable recruitment materials, deliberate partnering is also significant as it “can yield projects that do meld with existing programs” (Bonney et al., 2009b, p.980). In other words, the recruitment would be easier if the project activities could to some degree be integrated into the existing programme of the defined groups. If the above are tactical issues for facilitating public recruitment, a strategically important issue is to arouse resonance. According to Pocock et al. (2014), “it is irrelevant how important you think an issue is – it is how it resonates with potential volunteers which will determine how motivated they are” (p.19). Based on the existing practices, Pocock et al. (2014) stated that citizen science projects could resonate with people through various ways, ranging from a sense of place, a pre-existing interest, a sense of discovery, being part of a narrative, to a sense of jeopardy.

### **2.3.2 Facilitating participation**

While the recruitment is done, the next important issue for the organisation is to facilitate participation in citizen science activities. According to Bonney et al. (2009), it is critical for organisers to provide necessary support to participants that enables them to fully understand project materials and enhance their self-efficacy in data collection. In some cases, toolkits combining necessary information, instruction and other supporting material are provided to the participants, and it is the participants’ responsibility to read and learn the project materials before the data collection process. For projects conducted by groups, Bonney et al. (2009) suggested that as group leaders could receive information and guidance from project staff, further training opportunities are available to participants. They further explained that projects on regional scale could hold training workshops directly, while projects on a larger-scale could hold regional workshops in collaboration with cooperative organisations. Apart from the traditional approaches, new technologies has been increasingly used to facilitate participation in citizen science. But according to Roy et al. (2012), though “it was widely recognised that new technology... offer considerable

potential but the more traditional routes of engagement... remain highly relevant” (p.41).

In the above review, some researchers have suggested some general principal for recruiting participants and facilitating participation in citizen science. However, most of them have not taken into account the potential influence from the organisational settings of citizen science projects. Especially for a large-scale citizen science project, due to the complex organisational network, recruitment and facilitation approaches might be more diverse. Thus, this research explores how participants are recruited and how participation are facilitated by different partner organisations within a large-scale citizen science project, and examine how these two aspects are influenced by the organisational settings.

## **2.4 Public Engagement and its Influence**

### **2.4.1 The degree of public engagement**

In terms of public engagement, one of the landmark typologies was ‘a ladder of citizen participation’ from Arnstein (1969), in which eight different levels of participation was sub-categorised under three main levels, namely non-participation, tokenism and citizen power. Generated from the field of development studies, this typology highlighted the power relationships among authorities and different stakeholders within many social processes. In citizen science, the power relationships are mainly concentrated between professional scientists and the non-professional participants. According to Haklay (2013), many participants appreciate and respect the expertise of the professionals in citizen science projects. When participants improve their competence through active participation in the scientific projects, they are more likely to develop initiative and move up the ladder of participation, while participants in some projects would prefer to contribute passively without fully understanding the scientific research. Thus, there should not be a strong value judgement of the level of participation in a specific citizen science project (Haklay, 2013).

In order to relate participation to the outcomes of citizen science, Shirk et al. (2012) defined the degree of participation as “the extent to which individuals are involved in the process of

scientific research: from asking a research question through analysing data and disseminating results” (p.3). Based on this definition, they divided citizen science projects into five different models, namely contractual, contributory, collaborative, co-created, collegial contributions (see Table 2.1). In this typology, the degree of participation increases from non-participation all the way to independent participation from top to bottom, while the involvement of scientists gradually decreased correspondently. This classification takes into account both the roles of scientists and the public, and provides an inclusive and distinct classification to the degree of participation in citizen science. Based on this typology, most citizen science projects, especially those above the regional scale, are contributory in nature (Haklay, 2015), which in general are established by professional scientist while public participants primarily contribute data. However, the typology does not elaborate on more detailed levels of participation within this most common type of citizen science approach. Thus, this research aims at evaluating and elaborating on the degree of participation in a large-scale contributory citizen science project.

**Table 2.1 Five different models of citizen science**

<b>Contractual</b>	where communities ask professional researchers to conduct a specific scientific investigation and report on the results;
<b>Contributory</b>	which are generally designed by scientists and for which members of the public primarily contribute data;
<b>Collaborative</b>	which are generally designed by scientists and for which members of the public contribute data but also help to refine project design, analyse data, and/or disseminate findings;
<b>Co-Created</b>	which are designed by scientists and members of the public working together and for which at least some of the public participants are actively involved in most or all aspects of the research process;

<b>Collegial contributions</b>	Where non-credentialed individuals conduct research independently with varying degrees of expected recognition by institutionalized science and/or professionals.
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Source: Shirk et al. (2012)

#### **2.4.2 The influence of participation**

Regarding the influence of participation in citizen science, changes in participant's competence, attitude and behaviour might be the key factors for consideration. By conducting an investigation with citizen scientists in two conservation organisations in India, Johnson et al. (2014) conclude that participation in citizen science could enhance participants' self-efficacy. This could be seen from their research finding that the majority of volunteers reported they gained new knowledge and skills, or advanced scientific literacy through participation, and meanwhile they applied the new knowledge and skills they acquired to other aspects of their life. Through working with individuals and communities across Scotland, Jones et al. (2013) concluded from their study that being engaged in citizen science activities provides participants with more than scientific knowledge; it can also have a significant and positive effect on their attitude and behaviour. This could be seen from their research finding that most respondents reported that participation has led them to feel stronger environmental attitudes and take more environmental action. Besides, more than half of the participants reported an increased sense of connection to nature. In particular, the effect on attitude and behaviour is more prominent within the existed citizen scientists group than in the new citizen scientists group, which indicates that the more one engages in citizen science, the more likely it would lead to a positive change in his attitude and long-term behaviour.

The above review shows that being engaged in citizen science could result in changes in the competence, attitude and behaviour of participants. However, whether these findings could be apply to a citizen science project on a larger scale remains unclear. Thus, this research

examines how participating in a large-scale citizen science project could influence participants. Together with the evaluation on the degree of participation, the research examines the influence of the organisational settings of a large-scale citizen science project on public engagement.

## **2.5 Sustainability of Citizen Science**

Environmental monitoring and many other areas require long-term investment and involvement, thus how to maintain sustainable development is a significant issue for many citizen science projects. In terms of maintaining sustainability of a citizen science project, the most frequently mentioned issue is funding. In regard to funding, Dickinson et al. (2012) suggested that sustaining funding support for cyberinfrastructure, databases, and project leadership are main challenges for most citizen science projects. According to Bonney et al. (2009), to run an effective citizen science project, elements like staff's dedication in directing and managing the projects, volunteer support, as well as data gathering, analysis, and management are indispensable, all of which could be costly and require sustainable funding. Just as many other scientific research, citizen science projects also need to constantly seek and strive for available funding to sustain its operation. Thus, how to achieve long-term funding support and how to distribute funding within a project are significant for the sustainable running of a citizen science project.

As volunteer contribution is indispensable for citizen science, how to involve participants and keep their long-term engagement is equally important for sustaining a long-term citizen science project. Regarding sustainable involvement, a significant issue is motivation. According to Rotman et al. (2012) volunteers participate in citizen science out of personal interest, curiosity and commitment to conservation and relevant educational endeavours, but such motivations tend to be temporal, dynamic and changeable even without changing the ultimate goal. Besides, they highlighted two significant point-in-time, namely the initial encounter when a participant decides to join in a project, and the end of a project when he or she decides whether to keep contributing to other projects. These two points are very

important as participants' initial and persistent motivations determine whether a more sustainable collaboration between scientists and the citizens could be achieved from citizen science. To guarantee long-term and sustainable volunteer engagement, "their range of motivations should be repeatedly acknowledged and addressed throughout the project lifecycle" (Rotman et al., 2012, p.224).

From the above review, we could see that sufficient funding and staffing, as well as long-term engagement are the main issues for keeping the sustainable running of many citizen science projects. To some extent, these issues have a lot to do with the organisational settings of a project. Especially for a citizen science project running on a large geographic scale, as its organisational settings tend to be more complex, these issues would be more significant. Thus, this research examines how the organisational settings influence the sustainability of a large-scale citizen science project, with a focus on issues related to funding, staffing, and engagement.

## **2.6 Conceptual Framework**

The above review gives a general overview on different aspects of citizen science. In general, the study will look into a large-scale citizen science project and examine the influence of its organisational settings on different aspects of the project. Based on the research gaps identified above, the study aims at addressing the main research question through examining the following aspects of the project. Firstly, to have a comprehensive understanding of the organisational settings, the study will look into the state of governance and collaboration in the project. In terms of governance, the study will regard the project as a network governance system and examine three main aspects, namely formal and informal structures, relational and structural embeddedness, and macroculture within the project. In regards to collaboration, the study will evaluate scientific collaboration among scientists and other professional groups, as well as collaboration between scientists and the general public in the project. After that, the study will then start addressing the core research question through evaluating: the recruitment of participants and facilitation of participation by partner

organisations, the degree and influence of participation, and the sustainability of the project. By addressing all these aspects of the project, conclusions on the influence of organisational settings on a large-scale citizen science project will be drawn from the study.



### 3. Methodology

#### 3.1 Research Strategy

##### 3.1.1 Research design

To understand how organizational settings influence the operation of citizen science, it is necessary to look into different aspects of the real-life citizen science practice, and capture empirical insights from those involved in different parts of citizen science. Based on a realist ontological stance and an interpretivist epistemology, this research adopted an inductive case study method, which allows for a larger degree of inference by the researcher as compared to deductive approach (Bryman, 2012).

In order to give a comprehensive examination of the case, a mixed methods approach (see Table 3.1) was used in this study. As the research relied largely on the empirical experience of the key stakeholders of citizen science, the semi-structure interview was adopted as the primary data collection approach in this research to address most of the research questions. In order to obtain a more grounded perspective of citizen science, apart from interviews, observation and questionnaires were used as supplementary approaches to address two of the questions. Besides, secondary data sources was also used as an additional approach in the research to partly address the research questions. Once all the interviews were completed, a quasi-grounded theory approach was adopted in this research for analysing the data acquired from the interviews, from which the conclusions of the research were drawn.

**Table 3.1 Summary of Research Design**

Research Questions	Data Source	Data Type
1. What is the state of governance and collaboration in the citizen science project?	Semi-structure interview Secondary Sources	Qualitative

2. How do partner organisations recruit participants and facilitate participation?	Semi-structure interview Observation	Qualitative
3. To what extent are public participants engaged in the citizen science activities?	Questionnaire Observation Semi-structure interview	Qualitative Quantitative
4. How sustainable is the citizen science project?	Semi-structure interview Secondary Sources	Qualitative

### 3.1.2 Triangulation

To facilitate the validation of data in social research, it is helpful to involve cross verification via two or more sources. This is what has frequently been referred to as triangulation. As the main type of triangulation, combining different methods in one research allow observers to “partially overcome the deficiencies that flow from employing one single research or one method” (Nachmias, 2007, p.12). In this study, different types of methods- interview, observation, questionnaire and secondary sources- were used to improve the research’s validity. Apart from triangulating between different methods, triangulation between opinions from different stakeholder groups, such as project leaders, community scientists and volunteers, was also included in the study, which was summarised as another type of triangulation- data triangulation- by Denzin (1978). By employing different methods and including different stakeholder opinions, it is possible to reduce the bias in the research.

### 3.2 Case Study

According to Yin (1994), case study often uses an inductive approach to explore specific cases expansively and to generate theory from in-depth explanations. To examine the influence of organisational settings on a large-scale citizen science project, this research was

based on an in-depth case study of a typical citizen science project, through which significant attributes of the research questions could be explored in depth to explain the research problem.

### **3.2.1 Case selection**

As citizen science is a relatively diverse field, it is difficult to cover all disciplines and geographic scales within one research. Thus, this research focused on citizen science practice in the field of environmental monitoring within the UK. According to Silverman (2010), cases in a study would rarely be selected at random. A typical case might be chosen when “its analysis will reveal conclusions that can be taken as representative of a wider class of cases” (May, 2011, p.228). And generally, they should be selected in the light of criteria related to the research (Bryman, 2012). By conducting pilot interviews with project leaders of several citizen science projects in the UK, and comparing the typicality and suitability of those project, as well as the feasibility of data collection, the Open Air Laboratories (OPAL) project was chosen as the study case for the research.

There are several reason for selecting the OPAL project. Firstly, it is one of the largest and most well-known citizen science project in the UK, which has been frequently referred to as a typical example of citizen science in many official documents and academic articles. Secondly, as a UK-wide citizen science initiative, it has established a large governance and collaboration network that involve different types of partner organisations from across the UK. Thirdly, with a focus on environmental monitoring, it includes a variety of environmental surveys, covering areas like water, air, soil, biodiversity, etc. These reasons explain why OPAL is a typical and suitable case for the research. Besides, the approachability of the key stakeholders within the OPAL network guarantees the feasibility of data collection for the research, which is also one of the reasons for selecting it as the study case for the research.

### **3.2.2 Introduction of the selected case**

With a significant funding support from the UK national lottery programme, OPAL was originally launched in 2007 as a citizen science initiative across England. The first phase of OPAL (2007-2013) involved a variety of partner organisations, with the Imperial College London leading a partnership of universities, national bodies and the National History Museum. At the second phase (2014-2016), OPAL has gradually extended to Wales, Scotland and Northern Ireland, and has now become a UK wide citizen science programme. With a slight decrease in the number of partner organisations but a significant expansion in geographical scale, the current OPAL partnership is still led by the Imperial College London but includes only six organisations from the previous period and seven new organisations from across the UK. This research mainly focuses on the second phase of OPAL.

With a focus on environmental monitoring, OPAL runs a series of field surveys across the UK to engage the public. Started with the soil and earthworm survey, it has now included up to eleven different surveys, most of which runs a national scheme. In general, these surveys aims at exploring the tree health, the soil condition, the water and air quality, the value of hedges, and the distribution of invertebrates. To facilitate participation, most surveys provide easy-to-follow survey packs with survey instructions, education information, and identification guides, thus to make it easier for participants to conduct environmental monitoring activities of around an hour. With the help of community scientists across the UK, OPAL takes on a proactive role and cooperate with schools, local communities, voluntary groups and other environmental organisations to deliver the OPAL surveys. Participants could also download the survey packs online and conduct the surveys independently. Most surveys are paper-based and the results could be either submitted online or by post. Besides, an online platform based on website and smartphone app- the iSpot- is also used to facilitate participation. This research mainly focuses on the onsite surveys led by community scientists.

Differing from many citizen science projects that emphasis more on scientific research, the

OPAL project tries to strike a balance among social wellbeing, public education, and scientific research. Its objectives includes changing lifestyle, providing accessible education, improving public awareness and understanding of the environment, as well as strengthening connections between different social groups. This research will also evaluate to what degree the actual operation of OPAL could be said to have met these targets.

### **3.3 Sampling**

Before starting the interviews, an important issue is to identify potential groups of interviewees. I first looked into the OPAL website, and discovered a list of key stakeholders from the 13 partner organisations of the new project period. From the list, several important roles were identified: the director and the coordinator of the whole project, as well as the regional project leaders and the community scientists from each partner organisation. Apart from the list, the roles of community champions and public participants were also highlighted on the OPAL website.

#### **3.3.1 Snowballing**

After identifying the potential interview groups, I decided to begin with interviewing the coordinator of the OPAL project. In this way, I could first have an overall understanding about the operation of the whole project, and meanwhile gain recommendation to other stakeholders by the coordinator, thus to reduce barriers in approaching the potential interviewees. In this process, a snowball sampling method was used, which allows the researcher to build up more contacts through the initial contact person. After interviewing the coordinator of OPAL, I was recommended to approach several community scientists from different partner organisations. And though interviewing the community scientists, I was then put in contact with the community champions, and meanwhile gained access to the citizen science events, which allowed me to observe the survey activities and approach public participants.

Before all the interviews, I knew little about the operation of the project or the actual role

of different stakeholder groups. Using the snowballing strategy enabled me to get inside the OPAL network and allowed the network itself to develop the samples for the research. In addition, I contacted another stakeholder groups- regional project leaders- directly as a supplement to the interview samples developed through the snowballing approach.

### **3.3.2 Selection criteria**

In terms of the selection criteria, the research tried to cover interviewees from different stakeholder groups, different types of organisations, as well as different regions of the UK within the OPAL network. Regarding the stakeholder groups, six distinct roles were identified: the director is responsible for steering the OPAL project as a whole; the coordinator takes charge of coordinating the OPAL resources among all the partner organisations; the regional project leaders take the duty of steering the project in the partner organisations; the community scientists are in charge of delivering the surveys and facilitating participation; the community champions are volunteers who actively assist the project team in delivering the surveys; and participants are those who join the surveys and contribute data to the project. In regard to partner organisations, considering half of the partners in OPAL are universities, which might probably focus more on research and relatively less on public engagement, the research divided the OPAL partner organisations into two main groups: universities and other organisations. As for geographic location, as OPAL has extended to the whole UK, the four different countries- England, Scotland, Wales, and Northern Ireland- were all taken into account when selecting interviewees.

Based primarily on the snowballing strategy, I finally managed to approach 17 interview respondents in total. The respondents include four types of stakeholders identified above: 1 coordinator, 4 project leaders, 8 community scientists, and 4 community champions (see Table 3.2). In terms of each stakeholder groups, the selection tried to strike a balance between the two main types of organisations and the four different countries, which could especially be seen from the list of project leaders and community scientists being interviewed. It is worth mentioning that not all the interview requests received positive

replies. For example, I did not receive a reply from the OPAL director and one of the regional project leaders. And due to certain consideration of the community scientists, I did not gain permissions to interview public participants. Instead, I have to use the relatively less time-consuming approach- questionnaires- to gain some insights from participants.

**Table 3.2 List of interview respondents from the OPAL project**

<b>Stakeholder Group</b>	<b>Partner Organisation</b>	<b>Country</b>
Coordinator (Leading Partner organisation)	Imperial College London	England
Project leader (Regional Partner organisation)	University of Nottingham	England
	University of Aberdeen	Scotland
	National Museum Wales	Wales
	Queens University Belfast	Northern Ireland
Community scientist (Regional Partner organisation)	Newcastle University	England
	University of Nottingham	England
	University of York	England
	University of Aberdeen	Scotland
	Cofnod	Wales
	National Museum Wales	Wales
	North Wales Wildlife Trust	Wales
	Queens University Belfast	Northern Ireland

Community champion  (Regional Partner organisation)	Cofnod	Wales
	National Museum Wales	Wales
	North Wales Wildlife Trust	Wales
	Queens University Belfast	Northern Ireland

### 3.4 Data Collection

#### 3.4.1 Semi-structure interview

Due to the inductive nature of the study, an in-depth knowledge of the study case is required in addressing the research questions, which could be gained through empirical insights from different stakeholders of OPAL. Thus, the semi-structured interview was used as a main data collection approach in this study, as it allows the researcher to address specific questions without depriving the interviewees of their freedom to express other opinions (Bryman, 2004). Meanwhile, this approach enables the researcher to “have more latitude to probe beyond the answers and thus enter into a dialogue with the interviewee” (May, 2011, p.134). In this way, more grounded insights and experience of different interview groups could be gathered to form a more complete picture of the research issue.

As mentioned before, several pilot interviews were conducted before deciding the study case. After that, the snowballing technique was used to build up more contacts within the network of the selected case. Once a potential interviewee was confirmed, the interview could be done face-to-face, online, or by telephone call. As the interview respondents of the study case are distributed across the UK, most interviews were finally completed through skype and telephone call. In regard to different stakeholder groups, different sets of guiding questions were designed according to both the main research questions and the role of the respondents. Due to the semi-structured nature, all the interviews were conducted in a



relatively flexible and conversational way. As most interview questions are open-ended, interviewees had more freedom in presenting their own opinions and could respond to the questions more on their own terms. With new issues emerging from the completed interviews, the interview questions might be adjusted slightly, without changing the key themes of the interviews. With permission from the respondents, all the interviewees were recorded in the form of audio, which were then transcribed and coded for further analysis.

### **3.4.2 Observation**

To better understand how community scientists deliver the OPAL surveys and how public participants are engaged, the best way is to be involved as an observer in the survey activities. Thus, the observation was adopted as a supplementary approach in the research, which is regarded as “a purposive, systematic and selective way of watching and listening to an interaction and phenomenon as it takes place” (Kumar, 2014, p.173). With the permission from a community scientist and a community champion, I participated in two engagement events of OPAL respectively. Both events were held in Wales, one of which was in Amelia Trust Farm and the other was in Porthkerry Park. In general, there are two types of observations, namely the participant observation and the non-participant observation. In both events, I adopted the participant observation approach, in which a researcher “participate in the activities of the group being observed, in the same manner as its members, with or without their knowing that they are being observed” (Kumar, 2014, p.173). In this way, I was able to be part of the survey group, and observe the behaviour and interaction of the group members without interfering their normal activity, thus to gain a more grounded insight of both the group leaders’ role and the participants’ role in the citizen science activities. Differing from interviews which could be recorded as audios, the observation of the events was recorded in a narrative and descriptive form, using my own words.

### **3.4.3 Questionnaire**

It is worth mentioning that participating in the engagement events was the only possible

way for me to approach participants during the research period. As permission to interview participants was not granted by any interview respondents, questionnaires were used as an alternative approach to capture participation feedbacks from participants. With the permission from the organisers of each event, I asked each adult and teenage participants to fill in a questionnaire before the end of the activities. Considering the various education level of the participants, all the questions were designed in a way that is clear and easy to understand. Most of them are choice questions that focus on participants' experience in participation. As I was only able to participate in two engagement events, due to the relatively small number of participation in each activity, I received altogether only 21 completed questionnaires, with 10 from the event in Amelia Trust Farm and 11 from the event in Porthkerry Park. In terms of analysis, this sample size might not be big enough to draw any comprehensive conclusion. But as an additional approach for the study, the results of questionnaires were still very helpful for the research.

#### **3.4.4 Secondary data sources**

To have a comprehensive understanding of the research topic, it is necessary to adopt an iterative approach which permits simultaneous data collection and analysis (Bryman, 2004). Thus, secondary data resources were also used in this research to partly address the research questions. Secondary data is available-to-use information that has already been collected by others. Using this method, data could be collected through various ways, including policy documents, newspaper articles, project websites, project reports and so on. The advantage of this method is the wide range of data sources it could provide for analysis. However, using this methods, efforts need to be made to guarantee all data sources collected for the research are authentic, representative and credible (Denscombe, 2010).

### **3.5 Data Analysis**

Data itself does not produce any knowledge, it is the outcome of the data analysis that becomes knowledge, leading to progress in the selected field. Considering the explorative

nature of the research topic, the data analysis process of this research was based on a quasi-grounded theory approach. In general, this approach is built upon the traditional grounded theory, but provides flexibility for the researcher to modify the procedures of the traditional approach and include other approaches (Grbich, 2012). Opposite to traditional social science method that is used to test existing theory, the grounded theory approach is “the discovery of theory from data systematically obtained from social research” (Glaser & Strauss, 1967, p.2).

‘All is data’ is a fundamental attribute of grounded theory, which indicates that whatever gets in the researcher’s way within the research scene could be regarded as data. In this study, data referred to interviews, observation, questionnaires and other secondary sources. Though grounded theory tend to be more rely on qualitative data analysis, according to Layder (1993) “quantitative data and forms of analysis should also play a part in generating grounded theory” (p.127). According to Denscombe (2010), using contrasting methods could help move the analysis forward, through which one method could be used to inform another. Due to the various data sources of this research, a mixed-methods data analysis approach was used to analyse the data collected from the previous stage.

The main data analysis methods of this research were thematic analysis and comparative analysis, which were mainly used to analysis stakeholder responses from the interviews and questionnaires. Thematic analysis was used at the first stage of analysis, as it provides a rich description on the respondents' opinions and attitudes (Braun & Clarke, 2006) and enable similar thought clusters to be exposed effectively, from which the trend of certain phenomena could be deduced and a series of central themes and sub themes could be produced. Once key themes and patterns were generated, comparative analysis was then used to compare among responses from different stakeholders. According to Layder (1993), “the constant selection and control over comparison groups is part of the dynamic and emergent design of the research process and encourages the development of properly grounded theory” (p.44). Besides, emergent themes or patterns from the previous analysis were then corroborated against the data from the observation and other secondary sources,

thus to strengthen the robustness of the research findings, and add further insights into my research questions.

### **3.6 Ethical Consideration**

The main ethical concern lies in the semi-structured interviews. As the interviews involved direct contact with key stakeholders of the project and collection of personal data, informed consent was required before any interviews. In terms of this, a piece of information sheet that includes a brief introduction of the research and explanation of the voluntary basis of participation was send to each interviewee in advance. In the information sheet, interviewees were notified that they could still withdraw the interview at any time without giving a reason. As most interviews were conducted through skype and telephone call, the research only asked for verbal consent from the respondents. With their agreement, a record of the conversation was made. Finally, all data were kept confidential and anonymous, especially for people who might have conflicts of interest with other stakeholder groups.

## **4. Analysis**

### **4.1 Understanding the Organisational Settings**

#### **4.1.1 The state of governance**

As a UK-wide citizen science initiative, OPAL involves a variety of organisations and stakeholders from across the UK. To some extent, such a network of organisations and stakeholders could be regarded as a network governance system. To examine the state of governance in the OPAL network, this section looks into three different aspects suggested by Robins et al. (2011) to examine the effectiveness of a network governance system, namely formal and informal structures, relational and structural embeddedness, and macroculture within the project.

##### **1) Formal and informal structures**

In terms of formal structure, according to Robins et al. (2011), it refers to “the prescribed ‘framework’ of the organization” and “the formal configuration of roles and procedures” (p1296). In the context of OPAL, the formal structure involves all the partner organisations and the members within each partner organisation that are funded by OPAL. Table 4.1 shows the formal structure of OPAL at the second phase (2014-2016). At this phase of OPAL, there are thirteen different partner organisations across the UK. Among all these organisations, around half of them are universities. If the numbers of organisations allocated to different regions reflects a balance in geographic scale, there is an imbalance regarding the types of organisations in different regions. On the list, most university partners are in England, with only two in Scotland and Northern Ireland respectively, which result in a fact that England have only one type of partner and Wales have no university partners. As the leading partner in OPAL, the Imperial College London has a series of distinct roles that manage and support the whole project. For most regional partners, there are at least one project leader and a community scientist that manage and support the project on the regional level.

**Table 4.1 Formal Structure of OPAL (2014-2016)**

<b>Country</b>	<b>Partner Organisation</b>	<b>Roles</b>
England	Imperial College London (Leading partner)	1 Director; 1 Portfolio manager; 1 Coordinator; 1 Evaluation and Data Manager; 1 Web and Digital Manager; 1 Project Officer
	Newcastle University	1 Project leader; 1 Community scientist
	Plymouth University	1 Project leader; 1 Community scientist
	University of Nottingham	2 Project leader; 1 Community scientist
	University of York	4 Community scientist
Scotland	FSC Scotland	1 Project leader; 1 Community scientist
	Glasgow City of Science	1 Project leader; 1 Community scientist
	TCV	1 Project leader; 1 Community scientist
	University of Aberdeen	1 Project leader; 2 Community scientist
Wales	Cofnod	1 Project leader; 1 Community scientist
	National Museum Wales	2 Project leader; 1 Community scientist
	North Wales Wildlife Trust	1 Project leader; 1 Community scientist
Northern Ireland	FSC Northern Ireland	1 Project leader
	Queens University Belfast	1 Project leader; 2 Community scientist

(\* FSC Scotland and FSC Northern Ireland belong to one organisation- the Field Studies Council)

In fact, the OPAL partnership was mainly built upon the relationship between the regional project team within each partner organisations and the leading project team in Imperial College London. In general, the partner organisations are only regional bases that host the OPAL staff, which have little to do with the operation of the project. This insight was generated from one of the interviews and was agreed upon by most of the interviewed project leaders and community scientists:

*There's no formal association between the university and OPAL... As far as the university concern, it is just one of the many project that the staff bring in... In terms of partnership, university maybe has a role as a location and a base for the project. (Community Scientist, University of Aberdeen)*

Apart from serving as regional bases, most partner organisations have relatively weak connection with OPAL in other aspects. In other words, the partner organisations are nominally rather than actually involved in OPAL. To avoid confusion, in this study, the regional partner organisations mainly refer to the regional project teams of OPAL.

Within the formal structure of OPAL, there are a variety of roles supporting the project from different aspects. As the leading partner, Imperial College London involves various roles, which include steering, managing, and supporting the whole project, as well as coordinating resources among all the other partners. As a whole, it plays a significant role in connecting all the partner and strengthen the whole partnership, which could be seen from the comment of a community scientist:

*Imperial College is really proactive and have a strong communication between all partner groups... The constant communication is often of good help... As one of the really positive thing I would say about the OPAL project is how well Imperial College the team there... how well we are supported. (Community Scientist, Newcastle University)*

The regional partners are mainly responsible for delivering the OPAL surveys on the ground.

There are two main roles in the partner organisations: the project leader and the community scientist. In general, the project leaders take charge of steering the OPAL project on the regional level. As they already have formal posts in the partner organisations, they spend only part of their time in OPAL. By contrast, the community scientists were recruited to work for OPAL, thus they tend to be very proactive and spend most of their working hours publicising the surveys and engaging the public. Some community scientists are also partly involved in research, but outreach and engagement would still be their major tasks. As they accomplish the core part of the citizen science project, their roles are highlighted by most of the interview respondents.

In terms of informal structures, they are usually developed through the interaction processes around the formal structure and “can take on a role of enhanced importance” (Robins et al., 2011, p.1296). Due to the large-scale outreach objective and the limited staffing in each partner organisations, developing informal structures for OPAL is critical. In OPAL, such informal structures refer to a wide range of volunteers, schools, organisations and community groups that help deliver and promote the surveys.

On the OPAL website, the role of community champions- volunteers who actively assist the project team in delivering the surveys- is underlined. As most regional partners have only one or two community scientists, additional help is always needed in conducting large public events. Thus, most community scientists tend to recruit and train some volunteers to assist them in delivering the surveys. Those active volunteers would then be formalised as community champions by OPAL. The community champions could be volunteers from communities or universities, and they can also be staff of environmental organisations or members of grassroots groups. Some of them work closely with the community scientists, while some others could combine OPAL with their work and delivered the surveys independently. Specifically, their role could be seen from the comments from a community scientist and a community champion:

*We quite often use volunteers... We have volunteers from the University and*



*community as well. We have some volunteers who just come and do one or two sessions, and then we have the really committed champions that are out all the time...All our community champions will go out and lead our surveys without us going outside. (Community Scientist, University of York)*

*I started volunteering with [the community scientist] in 2014...I realised how good it was ...I really enjoy it, so I keep going back and back...Now I am a OPAL champion, I can promote it, I can do the survey myself with groups...I am now like a representative of OPAL. (Community Champion, North Wales Wildlife Trust)*

Apart from individual volunteers, or community champions, another significant part of the informal structures of OPAL is the wide range of informal partners involved in the project. To reach the relatively high outreach target across a large geographic scale, the community scientists usually cooperate with schools, organisations and communities across their region. In this way, they could make use of these informal partners' existing network and promote the surveys with a wider range of audiences. A figure from the OPAL' official website shows that there have been more than 3500 schools taking part in the OPAL surveys, and over 2800 organisations working with OPAL. Together with volunteers and community groups, they make up a huge and dispersed informal network beyond the formal structure of OPAL, which serve as a supplementary but indispensable component for OPAL.

## **2) relational and structural embeddedness**

In terms of relational embeddedness, it refers to “strong relationships within pairs of network partners” (Robins et al., 2011, p.1297). In OPAL, relational embeddedness is rare within its formal network, but tend to manifest in its informal network. From the interviews with the project leaders and community scientists, there are several partners working closely with Imperial College London in research, but apart from that, it's hard to find very strong connections between dyadic partners within the formal network of OPAL. Though some community scientists in neighbouring regions might work together in some events, due to

the long communication distance and the relatively high regional target, most regional partners tend to focus on the tasks in their own regions. Thus, the relational embeddedness between regional partners tend to be weak. However, beyond the formal network, the community scientists tend to work closely with schools, organisations and communities within their regions, which brings more direct benefits than working with other regional partners. In such cases, the informal partners usually shared similar values with OPAL, thus the relational embeddedness could developed through constant cooperation.

In regard to structural embeddedness, it was described as the degree of connection among members of the dyadic partners and the partners themselves (Granovetter, 1992). To some extent, structural embeddedness is based upon relational embeddedness but go beyond it. Within the formal structure of OPAL, as relational embeddedness is relatively weak, there is little space for the development of an overall structural embeddedness. Beyond the formal structure, relational embeddedness do exist between the regional partners and the informal partners. But there is a lack of a platform to connect the informal partners together and cultivate relational embeddedness among them. Without extensive relational embeddedness, there is not a strong structural embeddedness for OPAL as a whole.

### **3) Macroculture**

In general, macroculture refers to widely shared values and goals that could guide common actions. According to Robins et al. (2011) with a strong macroculture in place, “intentions and shared understandings about joint activity will cohere” (p.1297), while lack of a strong macroculture would lead to more conflict or contestation. From the OPAL website, we could see that the OPAL project involves a wide range of objectives, which includes changing lifestyle, providing accessible education, improving public awareness and understanding of the environment, as well as strengthening connections between different social groups. These goals are in general very evocative and inclusive, which make it easier for OPAL to be linked with or embedded in other groups or organisations. Within the formal network, most members of regional partners share some common values and goals with OPAL, which

could be seen from the comment of a project leader in Scotland:

*What interested me in OPAL is that it allows me to better understand citizen science, so it is an instrument worth for me to learn... I am very interested in Biological recording, and I find outreach science important in general, and I can connect to people around me... I hope to share my passion about the nature field. The most fundamental target of OPAL is to get people interested in nature, it is something I envisaged from when I was twelve. (Project Leader, University of Aberdeen)*

Compared with the formal collaboration that involves funding as incentive, the informal collaboration between OPAL and the informal partners tend to rely more on shared values and common goals. The fact that OPAL has managed to involve a variety of stakeholder groups across the UK in some sense reflects the inclusiveness of its objectives. Based on shared values and goals, it is possible to combine the OPAL surveys with the activities of the informal partners, which then allows joint actions to cohere. Among the interviews, Almost none of the respondents have mentioned any potential conflicts in the collaboration among regional partners or with informal partners. Based on the above analysis, we could see that OPAL as a whole has a relatively strong macroculture within its governance system.

#### **4.1.2 Multiple collaboration forms**

In terms of collaboration, as a citizen science project, OPAL first involve the collaboration between scientists and the general public. In terms of the level of participation or collaboration in citizen science, there are in general five different models, namely contractual, contributory, collaborative, co-created, collegial contributions (Shirk et al., 2012). As a citizen science project with a UK-wide outreach goal, OPAL was structured as a contributory citizen science project. This contributory nature could be seen from the description of OPAL by Haklay (2015), as well as the interviews with the OPAL project coordinator:

*I would say most of the work we do is contributory. Certainly, in national level, the*

*citizen science survey that we got are all contributory. People collecting data, citizen scientists don't necessarily get involved in coming up with those research questions or analysing those data afterwards. (Coordinator, Imperial College London)*

Differ from urban development issues that might involve conflicts of interests among stakeholders, citizen science is conducted on a voluntary basis and tend to be less conflicting. Though it is a contributory form of collaboration, in which participants only collaborate in data collection, the OPAL project is also designed to benefit the participants from different aspects. Such benefits are more or less reflected in OPAL's objectives, and will be elaborated more in section 4.3.2.

Apart from collaboration between scientists and the public, the OPAL project also involves collaboration among scientists and other professional groups. Specifically, it involves the three main types of scientific collaboration concluded by Sonnenwald (2007), namely cross-disciplinary, cross-geographical and cross-organisational collaboration.

Above all, cross-geographical collaboration is the major form of collaboration in OPAL, which could be seen from its formal structure that involves regional partners from across the UK. This type of collaboration is critical for a large-scale citizen science project like OPAL as it needs different groups of people to deliver the surveys from distributed geographic locations. With the project being extended from England to the whole UK at the second phase of OPAL, there is a significant cut in the number of English partners, while nine new partners from Scotland, Wales, and Northern Ireland were added to the network. This in some sense shows the significance of cross-geographical collaboration in OPAL.

In terms of cross-disciplinary collaboration, the formal OPAL network involves members with a diverse background and different expertise, which is considered by most interview respondents as very helpful for problem-solving and mutual-learning. From the research perspective, the diverse range of surveys are designed by scientific researchers from different backgrounds, and researchers with different expertise collaborate with each other

in producing research outcomes. From the practical perspective, most community scientists have an engagement background in nature, education or science teaching, which allows them to learn and get help from each other. Regarding the cross-disciplinary collaboration and its importance, some valuable insights are generated from the different interview groups:

*We have these five research centres, there will be the air centre, the water centre, the biodiversity centre and etc.... In terms of the surveys, they were developed by the whole partnership, and there is opportunity for everyone to feed into those process (Coordinator, Imperial College London)*

*It's OPAL as a whole generating the data through citizens who voluntarily give the data, and then it's much more of a share and discussion what should happen... You want to engage citizens and you want to do a wide set of things, and you can't do it on your own. So having a diverse range of groups and people with different skills is fantastic. (Project Leader, University of Nottingham)*

*They are super helpful... It just depends who got the expertise in the area that you are working on every time, so it's always going to be two or three partners... who have absolutely the knowledge you need to push everything forward. (Community Scientist, University of York)*

Besides, cross-organisational collaboration is also an important collaboration form in OPAL. As could be seen from the formal network of OPAL, there is a variety of partner organisations involved at the second phase, which includes universities, museum, charities and so on. Apart from the formal structure, there are a wide range of schools, organisations and community groups working with OPAL in an informal way, which all contribute to the diversity of cross-organisational collaboration in OPAL. With a diverse types of organisations involved, it is easier to address both research and practical issues.

## **4.2 The Role of the Regional Partners**

Regarding the role of the regional partners, it is mainly about outreach and engagement. Thus, it is necessary to highlight the role of community scientists who take charge of publishing the surveys and facilitating participation on the ground. These two main aspects of the project operation on the regional level will be elaborate below.

### **4.2.1 Publicising the surveys and recruiting participants**

Before any survey could take place, the most important issue is to publicise the surveys and recruit potential participants. It is worth mentioning that most partners and their community scientists joined OPAL only from its second phase. For those partners that have been involved from the first phase, most of them changed their community scientists in the new project period. As everything is new when joining OPAL, the very first task for most community scientists is to contact potential groups and establish network. According to the interviews, very few of the community scientists regarded the partner organisations' network as helpful. Indeed, most of them needed to establish a regional network by themselves. For each partners, there is an outreach target set by OPAL for the second phase, which varies among different regions. For example, it is to reach around 7000 beneficiaries in the Northeast Scotland (University of Aberdeen), and around 5000 in the Midlands of England (University of Nottingham). Additionally, each regional partner is required to cover around 20% disadvantaged groups within its total target. In order to achieve the relatively high target, the community scientists tried many different ways to publicise the surveys and recruit participants.

According to the interviews, the most commonly used approach is through working with schools. As outdoor activities are usually welcomed by teachers, the community scientists could easily reach high number of beneficiaries by working with schools. This could be seen from the interviews with two of the community scientists:

*The teacher love it, when people bring in activities for the students to do. Teacher will*

*get them out of the classroom, and it hit all of their targets for kind of educational stages. (Community Scientist, University of York)*

*It's quite easy to get quite big numbers by working with schools (Community Scientist, National Museum Wales)*

Another commonly used approach by most community scientists is to cooperate with other organisations in delivering the surveys. Due to the limited funding and staffing, it is difficult for the regional partners to hold public events regularly and independently. Thus, the community scientists tend to hold public events with other organisations or promote the OPAL surveys through other organisations' activities. In this way, they could make use of the organisations' existing network, and introduce the OPAL project to the organisations' members and audiences. For the organisations, they usually welcome such cooperation as the OPAL resources are very helpful for them. The mutual benefits could be seen from the comment of a community scientist from Northern Ireland:

*I am also working with other organisations... They are engaged with the public all the time. So they can promote OPAL for us... because they have network as well, and to use their network. And they are all happy to use the OPAL resources because they find them very useful. (Community Scientist, Queens University Belfast)*

The high numbers of schools and organisations that have worked with OPAL (highlighted on the OPAL website) in some sense show the popularity of the above two approaches among community scientists. Apart from working with schools and organisations, the community scientists also promote the OPAL project through large public event, such as festival, fair and conference. Regarding this, a community scientist in Northern Ireland shared with me the wide range of public events she attended to promote the project:

*I also attend events that are happening in Northern Ireland. I don't organise any, but I attend other people's events. Like the Belfast council has a spring Fair, I will go there. Like agricultural show, a very huge agricultural show in Northern Ireland every*

*year, I go to that. In other large events that is ongoing every year, I attend them... Like teachers conferences, I go to that as well. (Community Scientist, Queens University Belfast)*

Besides, the community scientists work with local community groups as well, especially those in deprived areas. Compared to schools and organisations, such groups are not very approachable. In such cases, the community scientists usually need to promote the surveys through someone who are familiar with the groups. In terms of publicising the OPAL surveys in a disadvantaged community, a community scientists in Wales told me her experience:

*It's been quite tricky working with these kind of communities because they don't tend to respond to posters or fliers. What they tend to respond to is somebody that knows them... So mostly, for those kind of events, I work with the project officer, or similar post, or community leaders sometime, and that person do really advertise the events. (Community Scientist, National Museum Wales)*

It is worth mentioning that as most community scientists has worked in the engagement field before, they also use their personal network as a complimentary approach to publicise the surveys. In addition, most community scientists also make use of social media like Twitter or Facebook to promote the OPAL project. The main advantage of the online approaches is that they are very quick in publicising the events, but there was also a doubt from the community scientists that they might not be effective in recruiting participants:

*I use twitter... I do use it to promote some events. But I have to say that I don't know how useful it is to actually getting the public on the events. (Community Scientist, National Museum Wales)*

Overall, affecting by the organisational setting, the OPAL project is publicised though a variety of ways. Differ from some online citizen science projects, OPAL relies largely on direct contact with people in recruiting participants. It is worth mentioning that, 'deliberate



partnering' (Bonney et al., 2009b) is often taken into account in different approaches. For example, when working with schools and organisations, the community scientists would try to combine the OPAL surveys with the schools' curriculum and the organisations' activities, thus to enlarge the benefits for both sides. In terms of 'arousing resonance' (Pocock et al., 2014), though it is not directly mentioned in most interviews, the diverse range of stakeholders involved in OPAL and its relatively strong macroculture all imply that OPAL resonates with its partners and participants to a certain extent.

#### **4.2.2 Facilitating participation**

Once a potential group of participants are contacted and agree to take part in the surveys, the next important issue is to facilitate their participation. As most participants might have little knowledge of the topic and might not be familiar with the surveys, it is necessary to provide them with some basic training. For engagement events, the community scientists could provide training to participants face-to-face before the surveys. But due to the limited staffing and the high number of participants, it is difficult for them to provide training to all the participants directly. Thus, the community scientists often provide training to those who lead the groups, thus they can go on to train the other members to do the surveys without the community scientists' presence. For schools, the community scientists would go and work with students directly, and they also provide training to the teachers who can then train their students and do the surveys with them; for organisations, the community scientists would provide training to the members, thus they can go on and deliver the survey to their audiences. Besides, they also train volunteers like community champions to help them deliver the surveys further. These approaches could be seen from the interviews with a community scientists:

*I mostly train the teachers, in a way, I do kind of do with children directly every time I go to a primary school. Because in that way, you are training the teacher as well. I always try to make sure they are always there, so they can see how it is done, and get the idea of how they can take it away. (Community Scientist, National Museum Wales)*

*It might be a formal training workshop, in which case I approach the organizations and saying: “would you like some training on some of the OPAL surveys to work with the audiences?”... And then I will go and do a formal training session... so they can go on and deliver OPAL to their end users. (Community Scientist, National Museum Wales)*

In addition to training, facilitating participation on site is another important issues. For onsite survey activities, much preparation work need to be done in advance. Take the engagement event in the Amelia Trust Farm for example: before the event, the community scientists had to prepare all the survey packs (such as identification guides and recording sheets) and the necessary tools (such as brushes, dustpans and nets); upon arriving on the site, she needed to identified two suitable survey sites (two 10m×10m areas with diverse habitat types) and marked them with strings; after that, she needed to draw the shape of each habitat type on the survey sites onto the 10x10 grids; besides, she also needed to prepare other things like small gifts with the farm leader. The preparation work may vary according to different surveys and participation groups. But in general, it involves the preparation for survey materials and the identification of survey sites. When participants are ready, the community scientists or group leaders will start the surveys with them. In general, the participants will first be gathered and taught about some background knowledge and how to do the surveys, then they will be broken into small groups to do the survey themselves. The community scientists or the group leaders will stand by and assist the participants differently according to their ages. Below is the comment from a community scientist on how she facilitated participation in the OPAL surveys:

*The first thing I will do is to get the group to form a big circle, talk them through a little of the background to the survey... And usually I will break the groups into smaller groups, so that they can be working on individual a bit... We will look at exactly where they are, what's around them...and then we will just step by step run through the methods. If it is an older group, I might just give them the book themselves, and let them go for it, and be there to help them out on specific difficulties. If it is a younger*

*group, we will go through it task by task...It depends on the age of the group.*  
(Community Scientist, University of York)

In many cases, as participants might come from different education background, it might not be effective to engage them all in the same way. A ‘differentiation’ technique is useful in such cases, which means to engage participants with different interest and level of capacity differently. Regarding this, a community scientists shared with me her experience:

*You can't take some people on the entire journey to complete a citizen science survey, because they have come in in too low level, so what you try to do is make sure they have fun and trying to make sure they learn something, and then they would aware there is a further place they can go to and where they can get all the information... Maybe you will get some family who are really quite engage and know quite a lot, for them, you want to move them to complete a survey. That's call differentiation.*  
(Community Scientist, National Museum Wales)

Besides, some interview respondents also mentioned the importance of rewarding in encouraging participants to be more engaged in the surveys. This could be seen from the comment of a community champions from Wales:

*If they get a small reward... something small, that say that they have done the survey, it will encourage people to do them more... You can try to put them into competition as well, so they just want to finish the surveys and wins them, giving them something to work towards.* (Community Champion, North Wales Wildlife Trust).

In summary, the community scientists facilitated participation by providing direct or indirect training to individuals and groups in advance, as well as guiding participants through the surveys on site. As OPAL is mainly based on onsite surveys, the effectiveness of participation relies largely on face-to-face facilitation provided by either community scientists or group leaders, while new technologies is seldom used.

### 4.3 Public Participation in the Surveys

#### 4.3.1 Low level of participation

Due to the contributory nature of OPAL, participants only take part in the data collection process within the whole project cycle, which means that they play a relatively passive role in the project. In this sense, OPAL as a whole is theoretically a relatively low-level participation project among different citizen science models. As OPAL aims to cover a wide range of audiences, most surveys are designed on an easy-to-use basis. And considering the efficiency and operability from across a large geographic area, most surveys are designed as one-off surveys which required ideally less than one hour's participation. But in practice, the participation process then to be longer, as a community scientist said in the interview:

*Ideally it needs a bit longer, as you start to introduce the whole context, and it's a bit more time at the end to get feedback, to discuss the results and put them into the computer, to do an evaluation form... I think it is all part of the engagement... because you are trying to teach people something and people are wanting to learn, they have to have the opportunity to stop...and ask questions and think about what they all means a little bit. (Community scientist, University of Aberdeen)*

The above comment indicates that participants need more time to think about and digest what they are doing, rather than simply do what they are told to. However, though most community scientists have realised this issue, they are not always able to guarantee enough time for participation. And the time they could spend with each participants depends largely by the size of the event and the number of participants they have. But no matter what level of participation, all the participants are counted equally as beneficiaries within the OPAL target, which indicates a lack of incentives for community scientists to conduct in-depth engagement in the project. Such concern is reflected in the conversation with a community scientist from England:

*Some of these events we got 200 people and may talk to each person for 10 minutes,*

*you know, it's a faint level engagement; and other events, we might have 10 or 12 people, but I will be working with them all day long. And they are all counted as beneficiaries in the same sort of way... which I think is one of the problems with this sort of engagement project. (Community scientist, University of Nottingham)*

To a certain degree, this low-level engagement issue has a lot to do with the organisational settings of OPAL. With limited funding, each regional partner could only support limited staffing. As they all have a high target to reach and a large area to cover, it inevitably results in low-level engagement in delivering the surveys. Regarding this, a project leader in Scotland gave a critical insight:

*Maybe it works better at a smaller scale...it could be a bit of rethinking on how much focus should be there on reaching high numbers. But that's simply decided by the funding. So there is not much we can do about that... in many case, there will be outreach that is so light-touch with little value. (Project Leader, University of Aberdeen)*

To examine the engagement level in practice, I participated in two different engagement events, both of which involved OPAL surveys. In the family event in Amelia Trust Farm, which is led by a community scientist and a staff from the farm, the participants are involved in two surveys- the bug count survey and pollination survey- in the same morning. They were made up of different aged groups, ranging from little kids to the aged, and none of them had participated in similar kind of activity before. Before both surveys, the community scientist taught them some background knowledge and how to do the surveys (see Figure 4.1). Though the instruction of the survey is relatively easy to follow, as there is a variety of species listed on the identification guide, it is hard to be familiar with them in a short time. In fact, they were not required to do so, and the survey started soon after the basic training (see Figure 4.2). Each survey lasted less than 20 minutes. Within the short periods of time, the participants only needed to recognise and write down the insects they found. After the surveys, they were invited to join a small rewarding activity.





**Figure 4.1 Training before the survey - Amelia Trust Farm**

(Photo taken on 8<sup>th</sup> May, 2016)



**Figure 4.2 Participation in the survey - Amelia Trust Farm**

(Photo taken on 8<sup>th</sup> May, 2016)



The Wildlife Watch event in the Porthkerry Park was a bit different from the prior one. It was organised and led by the park rangers and volunteers, and the participants were involved in only one survey- the pollination survey- in the morning. Though the survey was also new to all the participants, they had participated in similar activities before. Thus the survey started directly without training, and the participants did the survey together by following the survey instructions step by step (see Figure 4.3). The procedure of the whole survey was more or less similar with the prior event, except that the participants had a bit more time doing this survey. After the survey, there was also an additional rewarding activity.



**Figure 4.3 Participation in the survey - Porthkerry Park**

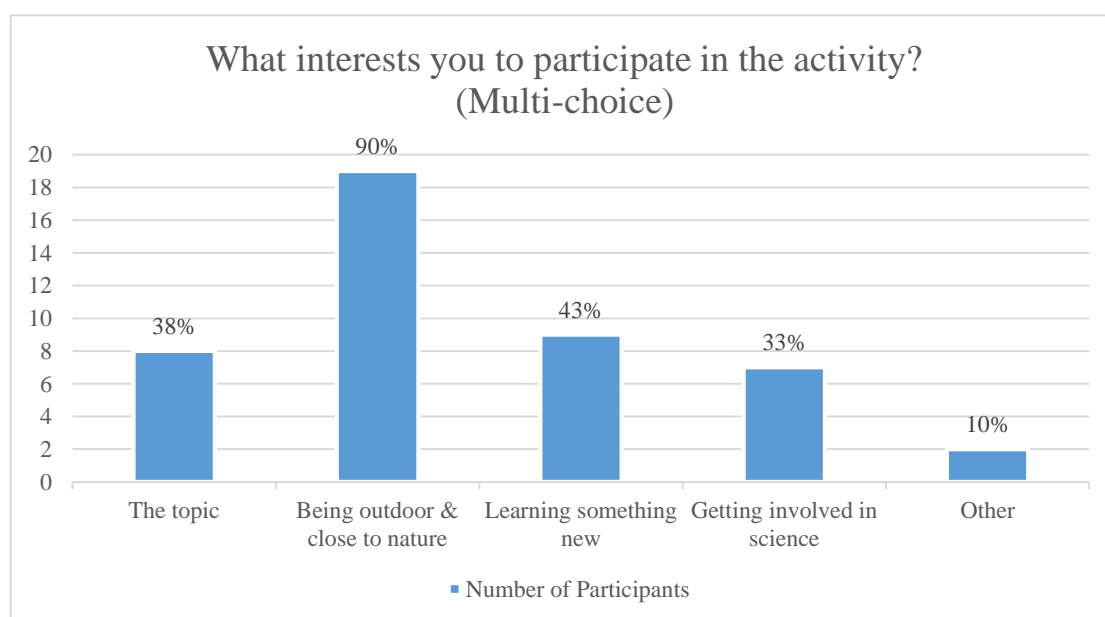
(Photo taken on 4<sup>th</sup> June, 2016)

In both the two events, the engagement process seemed to have met the basic requirements of the surveys. However, none of the survey allowed enough time for an in-depth learning beforehand, and there is a lack of reflection and discussion after each survey. Though there were small discussions during the participation, due to the time limit, they tend to be short. Therefore, the participants were engaged to a relatively low level in both events.

To sum up, in theory, the contributory nature has decided that OPAL is a relatively low-level participation model; in practice, due to the contradiction between the high target across a large area and the limited staffing within each partner organisation, participants tend to be engaged to a low degree in the OPAL surveys, especially in large events. Even in the two small engagement events I participated in, the participants were not able to be fully engaged in the surveys. These in some sense shows the dilemma of choosing between the quantity and quality of participation in a large-scale citizen science project like OPAL.

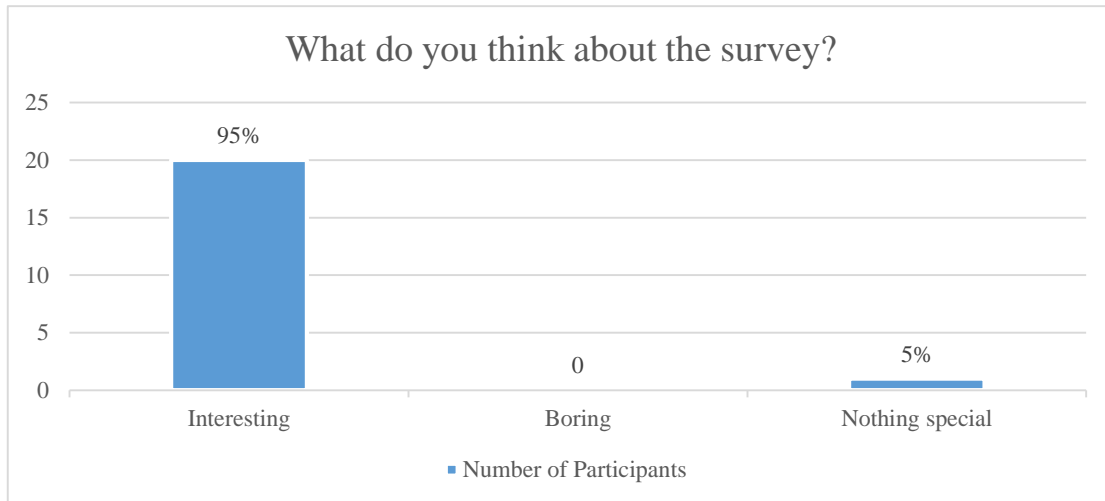
#### 4.3.2 The influence on participants

Though the above two engagement events involved relatively low-level of participation, the questionnaire results of both events showed that the participants tend to feel positive towards the OPAL surveys. Regarding the initial interests of participation, 90% of the participants chose ‘being outdoor and closed to nature’, which is largely in line with the main objective of the OPAL (see Figure 4.4). As for the general impression on the surveys, 95% of the participants regarded them as interesting (see Figure 4.5). Though this result might has something to do with the additional rewarding activities after the surveys, it in general shows that the engagement events are conducted in a relatively relaxed and enjoyable way.



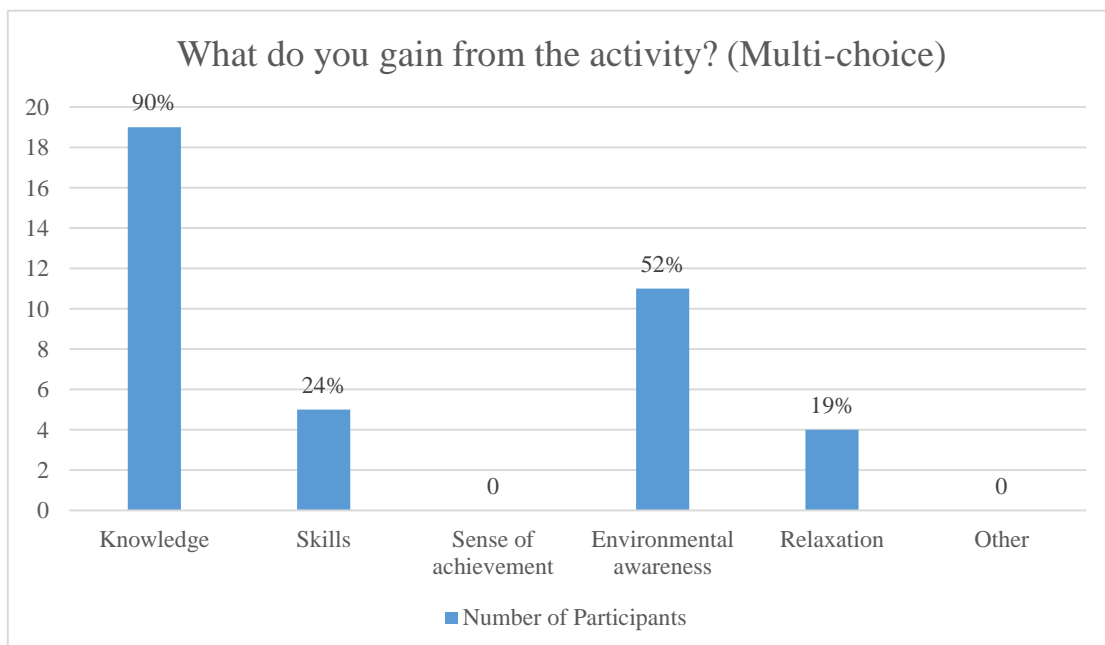
**Figure 4.4 Initial interests of participation**



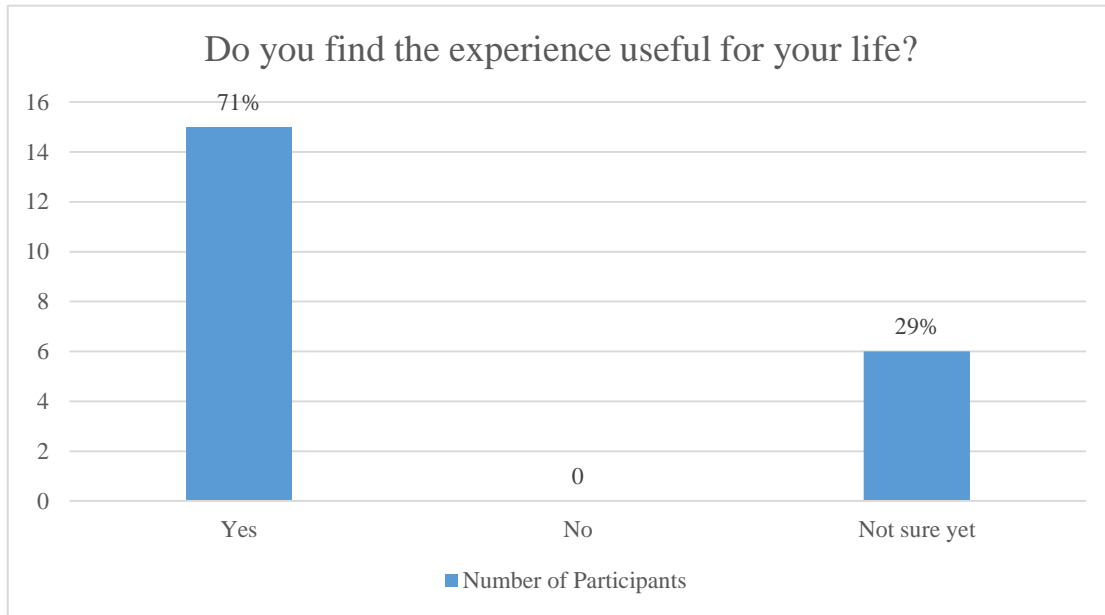


**Figure 4.5 General impression on the survey**

Regarding what they gained from the participation, 90% of the participants thought they gain new knowledge, 52% thought it help raise their environmental awareness, 24% thought they gain new skills, and 19% took it as relaxation (see Figure 4.6). Besides, 71% of the participants regarded the participation experience as useful for their future life (see Figure 4.7). Regardless of the low-level engagement nature of OPAL, the results shows that participating in the surveys could benefit the participants to a certain extent.

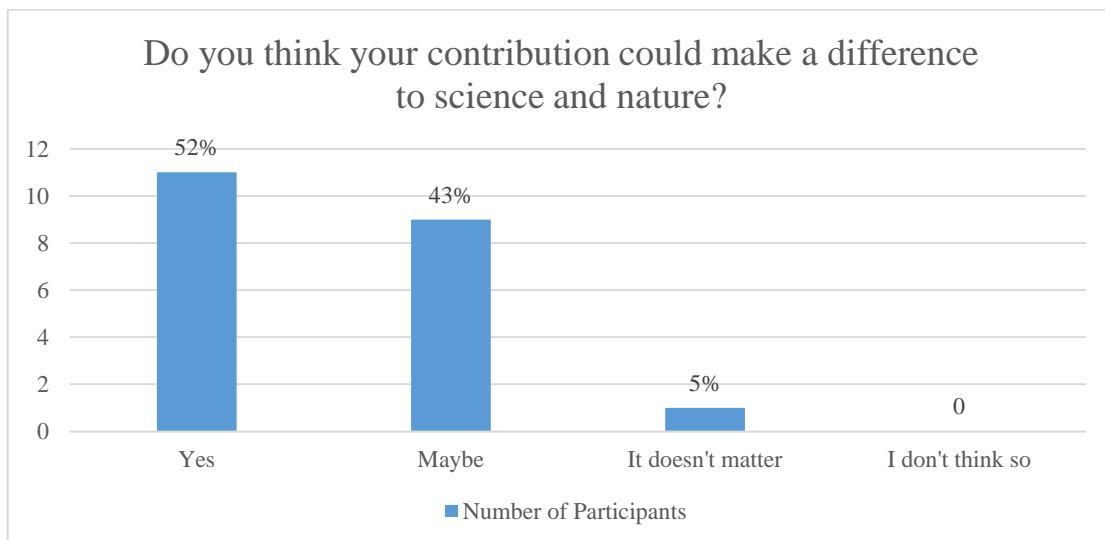


**Figure 4.6 Achievement from participation**



**Figure 4.7 Relevance of the experience for life**

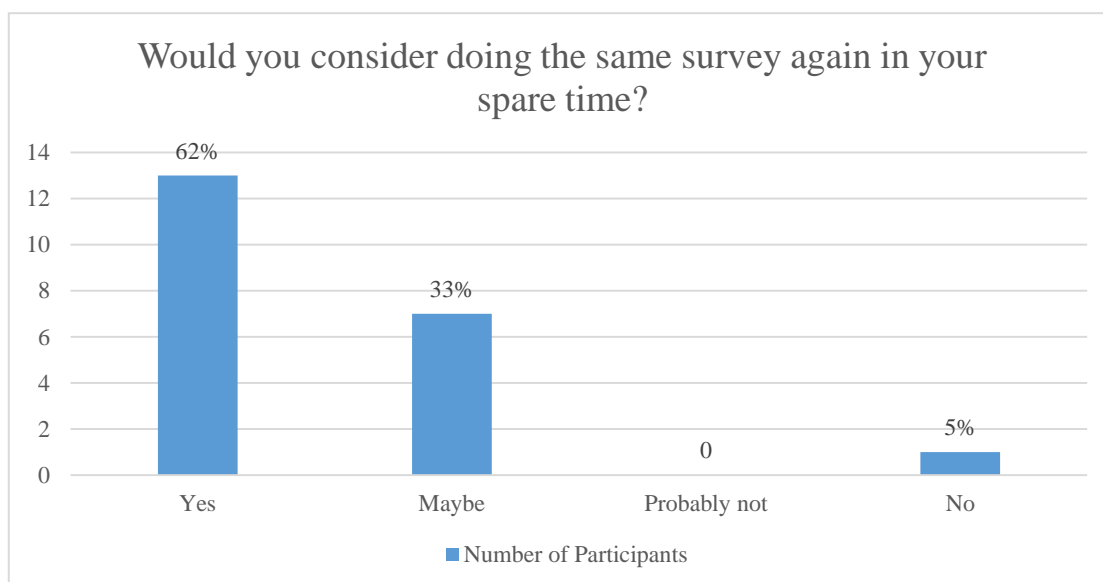
When asked about their opinions on whether their contribution could make a difference to science and nature, 52% of the participants chose 'yes' and 43% of them chose 'maybe' (see Figure 4.8). This shows that participants gain a certain degree of fulfilment from the participation.



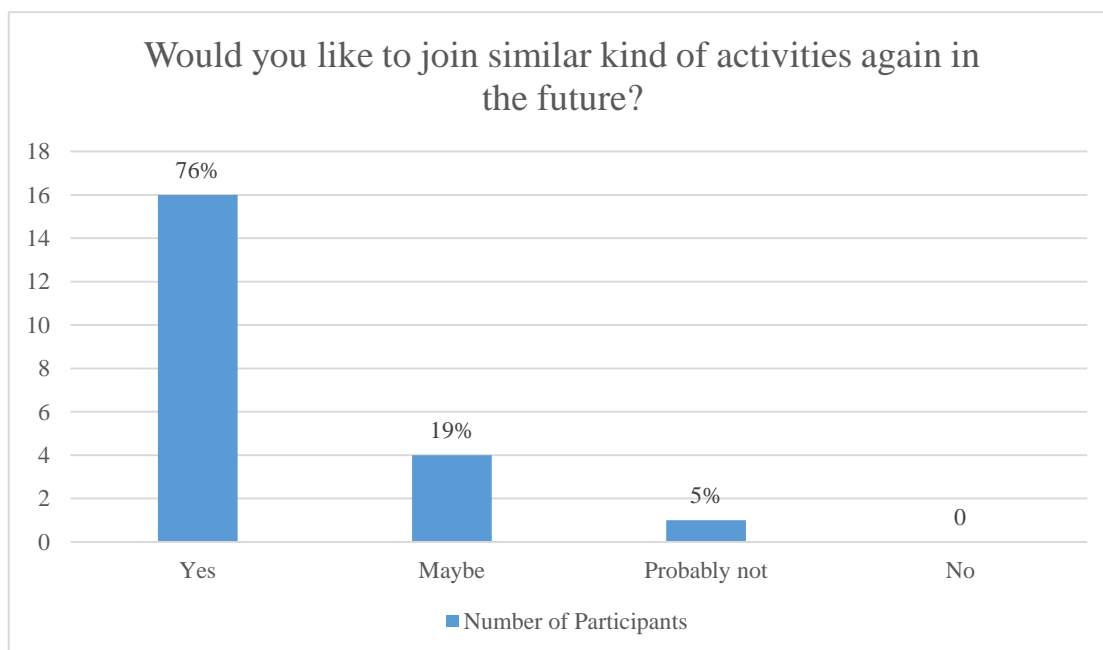
**Figure 4.8 Awareness of contribution to science and nature**

In terms of whether they would consider doing the same surveys again in their spare time, 62% of the participants chose 'yes' and 33% chose 'maybe' (see Figure 4.9). As for whether

they would like to join similar kind of activities again in the future, 76% of the participants chose 'yes' and 19% chose 'maybe'(see Figure 4.10). These results in some sense shows the participants' satisfaction about the participation experience and indicates that engaging in the OPAL surveys might have a positive influence on participants' attitude and behaviour.



**Figure 4.9 Willingness to join the OPAL survey again**



**Figure 4.10 Willingness to join citizen science activities again**

Overall, the positive feedback shows that the OPAL surveys as a whole is an effective way of getting people outdoor and close to nature, providing them with new knowledge and skills, as well as raising their environmental awareness. As one of the community scientist said below, apart from the above benefits, the OPAL surveys could facilitate social communication as well:

*They learn science and skills, they learn how to do a survey, they learn about the plants and animals, the local environment, and to meet other people, it can be a social events too. (Community Scientists Belfast)*

Overall, low-level of participation in citizen science could also bring about social benefits, though being more engaged could certainly maximise those benefits. As a citizen science project, OPAL combines both research and outreach purposes. From the research perspective, the contributory nature decides that the OPAL project is a relatively low-level participation model. From the outreach perspective, regardless of the low-level engagement, the OPAL project is overall an effective tool to increase public's environmental knowledge and awareness, promote social connection, and encourage a change of lifestyle. In this sense, OPAL could be said to have met most of its objectives.

## **4.4 Sustainability of the Project**

### **4.4.1 Large reliance on funding**

Unlike many online citizen science projects, OPAL is based on onsite surveys across the UK. Due to such nature, the operation of OPAL relies heavily on funding. Overall, OPAL consists of two main funding periods. At the first phase (2007-2013), OPAL received a £1.7 million grant by the Big Lottery Fund to roll out across England; and at its second phase (2014-2016), it was awarded £3 million grant by the same funder to extend to the whole UK. The difference in funding and geographic focus led to a significant change in OPAL's formal structure at the second phase, with the English partners cut down from fifteen to five and eight new partners added from Scotland, Wales and Northern Ireland. Such a significant

structural change reflects that funding has a large influence on the OPAL partnership. Though the previous partners may continue to play a role in OPAL, without a formal partnership, their contribution tend to be limited. From the interviews with four different project leaders, they all regarded funding as essential in sustaining the project, and they considered the current partnership as unsustainable without funding, which could be seen from the following comments:

*So running the partnership, the main difficulty is getting sustainable funding. (Project Leader, University of Nottingham)*

*[Funding is] very essential. It's not sustainable without funding at the moment. (Project Leader, University of Aberdeen)*

*The model works at the moment is because we are paying...What's going to happen when the funding stops, usually 'good bye'. That's the difficulty. Without money, we can't do anything. (Project Leader, National Museum Wales)*

The current period of funding is only until the end of 2016. All the interview respondents still have no clue whether the funding will extend or not. From the interviews, most project leaders and even some community scientists showed certain interests in seeking other funding to sustain OPAL or support similar kind of project when the funding come to an end. But no matter what source of funding, it could not change the fact that this kind of citizen science project could not run without continuous funding.

#### **4.4.2 Limited and unsustainable staffing**

Another significant issue for sustaining the project is staffing. According to the interviews, the majority of the OPAL funding is used to pay for the staff time of the community scientists. Their role is critical as OPAL need people to deliver the surveys on the ground. However, due to the limited funding, each partner organisation is only able to support one or two full-time or part-time community scientists. As these community scientists are very proactive

and could make use of volunteers and other networks, most of them have already reach or even exceed their target. According to the interviews, the current funding and staffing are enough to reach the target of OPAL, but it is far from enough to meet the local demands.

*We tend to be over subscribed. Too many people wanted to work with us... The current number of community scientists is enough to meet our target, however, it's not enough to meet the local demands, because we are often having to say no to people because we simply don't have time to do everything. (Community Scientist, University of Nottingham)*

Though most respondents reflected that the regional project is functioning well with the current resources, the current level of staffing is not enough to achieve a wider influence on the society. In terms of staffing, another important issue deriving from the interview is the sustainability of staffing. As most community scientists spent a lot of time setting up the regional network to deliver the surveys, which connects strongly with the community scientists themselves. If they leave their current position, the network will no longer work. This issue is revealed in the comments of two community scientists:

*I think it's the community scientists who make OPAL work, having people on the ground... When the community scientists go, how much it reminds people that I want to do an OPAL survey. (Community Scientist, Newcastle University)*

*A difficulty to long-term engagement is the fact that we are not necessarily here long term... If you want to maintain a long-term engagement with the project, then you need people on the ground, community scientists or something similar to maintain those links, because otherwise people do just forget and move on and do something else. (Community Scientist, University of Nottingham)*

*OPAL has to try moving from one funding round to the next, to keep the project going. And the sad thing is that, you have spent a few years to building a partnership with local groups and things, and suddenly it is not there. (Project Leader, University of*

*Aberdeen)*

For regional partners, changing staffs between different project periods could mean a loss of network resources for OPAL. This is evident in some partner organisations that have been through two project periods and changed their community scientists in the new period. In such cases, the new community scientists usually need to establish the network again.

#### **4.4.3 Short-term engagement**

With a significant funding support from the Big Lottery Fund, the objectives of OPAL are shaped largely by its funder. A major goal of OPAL is to allow more people from across the UK to get close to nature, especially those from disadvantaged groups. In practice, this goal is translated into high targets for community scientists in each region. However, due to the UK-wide coverage of OPAL, the funding is only able to support very few community scientists in each region. The high target and limited staffing thus determines the short-term engagement nature of OPAL. Firstly, considering the efficiency, most of the OPAL surveys are originally designed as one-off surveys. Besides, to reach the high number of beneficiaries in limited time, most community scientists tend to engage participants on a short-term basis. Such short-term engagement nature of OPAL could be seen from the comments of two community scientists:

*You have funded by Big Lottery who want you to reach high number of people. Then in order to do that, you obviously have to have some of the shorter term, one-off engagement. (Community Scientist, University of Nottingham)*

*Short-term is more dominant... especially when you get loads of people asking you to do things, and you don't want to say no to anyone. So it might mean, you work with more groups for a shorter time. (Community Scientist, University of Nottingham)*

With a pressure to achieve the OPAL target, the community scientists usually tried hard to reach as many beneficiaries as possible in the first year of their tenure, which inevitably

resulted in a fact that most participants were engaged on a short-term basis. In such cases, the benefit of participation is very limited and would also be short-term. Without an in-depth learning and repeated practice, people tend to forget about the surveys and return to their previous life afterwards. Regarding this issue, a community scientist from Scotland said that:

*I think the problem that it is easy to claim big numbers... but I am not sure how many people... would even remember that OPAL exist a couple days later... It's a difficult balance, but I think you have to do both. (Community scientist, University of Aberdeen)*

If we refer back to the two significant point-in-time suggested by Rotman et al. (2012), we could see that though most engagement events of OPAL might have considered the initial motivations of participants, they somehow failed to keep persistent motivations from participants afterwards. From the interviews, most community scientists have been aware of the issues related to the short-term engagement. As it is a structural problem for OPAL, they could hardly change the circumstance only by themselves.

#### **4.4.4 Efforts to sustain the project**

The above unsustainable issues have more or less been realised by different members of the OPAL network, thus they are making efforts to sustain the project from different aspects. In terms of funding, from the interview with the project coordinator, the leading partner- Imperial College London- is trying hard to extend the Big Lottery funding, as well as looking for alternative funding to sustain the project after the second phase. As mentioned before, some project leaders and community scientists are also interested in seeking other source of funding to sustain part of the project. These all show a great chance of OPAL being sustained after this funding period.

Regarding engagement, from the interviews, many community scientists reflected that since they have already reach their target, they are now considering more on making the engagement more sustainable. As most community scientists work quite a lot with schools, one of the most commonly used approaches is to integrate the OPAL surveys into the schools'



curriculum. In this way, the teachers would keep using the surveys as part of their teaching, and the students could gain more from the surveys by in-depth learning and repeated practices. However, some community scientists also concerned that as the teachers are facing new cohorts of students each year, it is difficult to keep long-term engagement with the same group of students. But compared to those one-off engagement, this approach is already much better to achieve a longer-term influence. Apart from that, some community scientists indicated that working with local groups and organisations is more possible to achieve long-term engagement, thus they are trying to embed the OPAL surveys in the groups or organisations, thus to hand over the project and make it more sustainable. This could be seen from the following comments of two community scientists:

*I think it rely on short-term engagement with individual and rely on long-term engagement with partners. (Community scientist, University of Aberdeen)*

*I am now more working with community groups and organizations in order to hand over the project, the sustainability of it... Now I am looking more at the kind of engagement which might lead to more sustainable use of the surveys. (Community scientist, National Museum Wales)*

Overall, the large reliance on funding, the limited and sustainable staffing, and the short-term engagement nature all lead to a fact that the current partnership and most engagement activities of OPAL are not very sustainable. However, the leader partners and some project leaders are trying to sustain the project with extension of funding and alternative funding sources. Besides, the community scientists are making efforts to sustain the surveys by embedding them in schools, communities and organisations, thus to improve the sustainability of the project.

## **5. Conclusion**

### **5.1 Summary of Major Findings**

#### **5.1.1 What is the state of governance and collaboration in the citizen science project?**

##### **1) Governance**

Involving a wide range of organisations and stakeholders across the UK, OPAL as a whole could be regarded as a network governance system. Thus, its effectiveness could be examined through the three main aspects suggested by (Robins et al., 2011), namely formal and informal structures, relational and structural embeddedness, and macroculture.

In terms of structures, the OPAL network involves both formal and informal structures. For formal structure, OPAL as a partnership network is nominally made up of thirteen partner organisations across the UK. But in fact, the actual partners are the regional project teams within each partner organisations, while the organisations themselves are merely serving as regional bases for OPAL. Among different stakeholder groups, the community scientists play a critical role within OPAL, because they are the ones who publicise the project and engage participants on the ground. But due to the limited funding and the large geographical coverage of OPAL, most regional project teams are only able to support one or two community scientists in total. To achieve the outreach target, the community scientists have to establish extensive networks by involving volunteers and cooperating with schools, organisations and community groups to deliver the OPAL surveys. Such networks then become the informal structures of OPAL. To some extent, the operation of OPAL, especially the outreach and engagement part, relies largely on its informal structures as most of the participants were recruited through these informal networks.

Regarding embeddedness, there is a certain degree of relational embeddedness but a lack of structural embeddedness in OPAL. Within the formal structure of OPAL, each partner organisation tend to work more on their own and there are lack of strong connections

between different partners. But beyond the formal network, the community scientists tend to work closely with many schools and organisations in the name of the OPAL. Thus, though there is no evident relational embeddedness within the formal network of OPAL, it do exist in its informal network. As for structural embeddedness, it is built upon extensive relational embeddedness. But due to the lack of relational embeddedness within the formal network or among informal partners, there is a lack of structural embeddedness for OPAL as a whole.

As for macroculture, it is relatively strong in OPAL. As the objectives of OPAL are very evocative and inclusive, they are easily in line with the values and goals of most formal and informal partners. Based on shared values and common goals, it is possible to combine the OPAL surveys with the activities of other organisations, which then enables joint actions to cohere. The fact that OPAL has managed to involve a variety of organisations and stakeholders across the UK in some sense shows that OPAL as a whole has a relatively strong macroculture within its network system.

## **2) Collaboration**

As a citizen science project, OPAL involves various collaboration forms. In terms of collaboration between scientists and the public, due to the contributory nature of OPAL, the public participants are mainly collaborate in the data collection process of the whole project. In regard to collaboration among scientists and other professionals, it involves three main types of collaboration conclude by Sonnenwald (2007). In regard to the cross-geographic collaboration, as the project is delivered across a large geographic area, the collaboration from different regional partners is indispensable. Regarding the cross-disciplinary collaboration, as OPAL involves a wide range of research topics, both the design of the surveys and data analysis require collaboration from different disciplines and expertise. As for the cross-organisational collaboration, considering the outreach target and the limited staffing, it is necessary for OPAL to collaborate with a variety of other organisations in delivering the surveys. All these collaboration forms are significant for OPAL and they together guarantee the effectiveness of the whole project.

## **5.1.2 How do partner organisations recruit participants and facilitate participation?**

### **1) Recruiting participants**

In regard to recruiting participants, it is affected a lot by the organisational settings of OPAL. On the one hand, there is a relatively high outreach target for each region. On the other hand, there are limited staffing in each partner organisation, and the organisations' network are usually not helpful for the project. Therefore, the community scientists need to establish the regional network and approach potential participants all by themselves. To reach the high target, they adopted various ways to publicise the surveys and recruit participants.

The most frequently used approaches are cooperating with schools and organisations. As the outdoor surveys are usually welcomed by schools and organisations, working with them allows the community scientists to deliver the surveys to large groups of students and a wide range of audiences. Besides, some community scientists also make use of large public events and work with community groups to publicise the surveys. As most community scientists have worked in similar field before, their personal network is helpful as well. In addition, social media is also regarded as useful to promote the surveys. But in general, the recruiting process is based mainly on direct contact with people rather than online. And within these approaches, deliberate partnering and arousing resonance are usually involved, which allow the OPAL surveys to be better embedded in schools, organisations and communities.

### **2) Facilitating participation**

Before any participation could take place, it is important to provide participants with some basic training. The ideal way is for community scientists to train participants face-to-face. But due to the limited staffing and the large number of participants, it is impossible to cover all participants. Thus, the community scientists tend to train the leading members of some groups who could then pass the training on to other members. In this way, the community scientists could provide training to a wider range of participants indirectly.

As OPAL is based on onsite surveys, the effectiveness of participation relies largely on face-to-face facilitation provided by either community scientists or those who lead the surveys. Before the surveys, there is much preparation work, which in general includes preparing survey materials and identifying survey sites. During the surveys, the differentiation and rewarding techniques were regarded as useful in guiding people with different interests and capacities and encouraging active participation. By facilitating participation on site, participants could have fun and be benefited from the surveys, thus they are more likely to come back again and help promote the surveys.

### **5.1.3 To what extent are participants engaged in and influenced by the citizen science activities?**

Theoretically, due to the contributory nature of OPAL, participants are only required to participate in the data collection process, which determines that the project is a relatively low-level participation model. In practice, due to the contradiction between the high target across a large area and the limited staffing within each regional partner, the community scientists were not always able to guarantee enough time for participants. Especially in large events, the time they could spend with each participants is very limited, which tend to result in lower-level engagement. Even for the two small events I participated in, the participants were not able to be fully engaged in the OPAL surveys either. In some sense, the low-level engagement issue has a lot to do with the outreach target of OPAL, which focus on approaching more beneficiaries rather than engage them more deeply. Without an incentive to promote in-depth engagement, it is hard to guarantee the quality of participation. To some extent, it is a dilemma of balancing between the quantity and quality of participation in a large-scale citizen science project like OPAL.

However, low-level engagement do not necessarily result in poor engagement experience. In contrast, it could also bring about good experience and social benefits. From the two events I participated in, the feedback from participants tend to be very positive about the participation experience. In both events, participants reported that they gain knowledge,

skills, and environmental awareness from the participation. Besides, the feedback shows that most participants enjoyed themselves in the surveys and gained a sense of fulfilment from their contribution. Furthermore, most of them would consider joining the same surveys or similar activities again, which indicates that participating in the OPAL surveys could have a positive influence on participants' attitude and behaviour. However, the positive feedback does not mean that low-level engagement is enough, instead, being more engaged could certainly maximise those social benefits.

In spite of the low-level engagement, the OPAL project as a whole is in general an effective approach to bring people close to science and nature, promote social communication and encourage lifestyle change. In this sense, it has met most of its objectives.

#### **5.1.4 How sustainable is the citizen science project?**

In general, there are three main issues affecting the sustainability of OPAL. Above all, the most significant issue is the large reliance on funding. As the project is based on onsite surveys across a large geographic scale, it relies heavily on funding to support the work of the wide range of regional partners. In some sense, the formal partnership of OPAL is built upon available funding. Without continuous funding support, it is difficult to sustain either the project or the partnership. The second issue is the limited and unsustainable staffing. In fact, the majority of the regional OPAL funding is used to pay community scientist to deliver the surveys on the ground. Due to the UK-wide coverage of OPAL, the funding is only able to support limited community scientists in each region, which are far from enough to meet the local demands. Besides, some partners changed their community scientists in the new project period, which might lead to a loss of the network resources established by the previous community scientists. The third issue is the short-term engagement in OPAL. To meet the outreach target from the project funder, most of the OPAL surveys were originally designed as one-off surveys. Besides, with limited staffing and a large geographic area to cover, the community scientists tend to engage most participants on a short-term basis. Affecting by these three issues, the current partnership and most of the engagement

activities are in general not very sustainable.

As a matter of fact, all the above issues are structural problems of the OPAL network, thus it is difficult for any individual members to address the issues alone. However, realising these issues, different members of OPAL are making various efforts to sustain the project. In terms of funding, the leading partner of OPAL is trying to extend the funding and looking for alternative funding. Besides, some project leaders are also considering seeking other funding to sustain the project. In terms of engagement, many community scientists are making efforts to embed the OPAL surveys in schools, organisations and communities, thus to make the project more sustainable.

## **5.2 Conclusion**

Overall, the organisational settings of OPAL have a significant influence on the project operation on the regional level. And such influence is most evident on the role of community scientists who are responsible for publicising the surveys and facilitating participation.

Firstly, as the OPAL partnership is built upon available funding, each regional partner has to reach a relatively high outreach target set by the funder. Secondly, due the large geographic coverage of the project, the funding is only able to support limited staffing on the regional level. Thirdly, as the partner organisations mainly serve as regional bases, their network is usually not helpful for delivering the surveys. Facing all these limitations, the community scientists have to contact and cooperate extensively with a variety of individuals and groups to set up the regional network. But the contradiction between the high target and the limited staffing inevitably leads to low-level engagement in many events. Furthermore, due to the large reliance on funding, the limited and sustainable staffing, and the short-term engagement nature, the current state of OPAL is in general not very sustainable.

It is worth mentioning that though the organisational settings affected largely the community scientists' role in OPAL, their role is indeed helping to frame the organisational settings as well. Firstly, the informal network of OPAL are mainly established through the community

scientists' contact and cooperation with various individuals and groups. Besides, their efforts to facilitate participation contribute a lot in cultivating relational embeddedness and macroculture within the OPAL network.

Based on the observation from two engagement events of OPAL, low-level participation do not necessarily result in poor experience, instead, it could also bring about social benefits and lead to positive attitude. Despite the relatively low-level engagement, OPAL has met its objectives of bringing people close to science and nature, promoting social communication and change of lifestyle. Though there are many issues affecting the sustainability of the project, the members of OPAL are making different efforts to make it more sustainable, such as seeking alternative funding and embedding the OPAL surveys into the informal partners.

In general, for large-scale citizen science projects, especially those adopting an onsite data collection approach, the organisational settings could have significant influence on different aspects of the projects. And the effectiveness of the project would be affected by issues like limited capacity and low-quality of engagement. Facing various potential issues, it is worth rethinking about how to sustain the project with limited resources, as well as how to strike a balance between the efficiency and effectiveness of participation.

### **5.3 Recommendations**

By examining the influence of organisational settings on a large-scale citizen science project, many issues have become apparent throughout the study. The key issues include the contributory nature of this kind of projects, the dilemma of choosing between the quantity and quality of participation, and the difficulties in sustaining this kind of projects with limited resources.

In terms of the contributory nature of this kind of projects, it might be helpful for smoothing the implementation process at the initial phases. But as the projects develop, it is necessary to make it more open to the public by gradually involving participants in other aspects of the project, like the initiation and design of citizen science activities. In this way, the project



could become more user-friendly and many hidden problems are more likely to be revealed from the participation process.

In regard to choosing between the quantity and quality of participation, it is necessary for the decision makers to examine the quality of the current engagement model and rethink about the meaning of reaching large numbers of participants if they are generally done on a low-level engagement basis. For the case of OPAL, it would be better if the decision-makers could lower the outreach targets for the future periods and provide incentives to encourage more in-depth engagement. In this way, it is possible to strike a balance between the efficiency and effectiveness of participation.

As for sustaining the project with limited resources, a direct solution is to increase the capacity of the regional partners by involving diverse sources of funding. In this way, the regional partners could recruit more staff (such as community scientists in OPAL) to deliver the project on the ground. Besides, another solution is to keep widening the informal networks and gradually formalise them, thus to involve more informal partners and encourage them to keep promoting the projects within their networks.

## **5.4 Limitations**

The main limitations of the research lie in the data collection approaches. Although the research tried to reduce bias by triangulating among different methods, due to the limited time-span and data accessibility, the results of each data collection approach were far from perfect. In terms of the semi-structured interview, the main deficiency lies in the lack of respondents from two of the key stakeholder groups, namely the project director and public participants. In regard to the observation, participating in only two activities of the project might not be sufficient to present the whole picture. As for the questionnaire approach, though it was only used as an additional method, its shortage was obvious, because the results of the relatively small sample size was insufficient to represent the opinions of the whole group. Regarding the secondary data sources, the abundance of data sources could

add to the difficulties in distinguishing rhetoric from practice. Besides, it was hard to guarantee that different source of data was based in the same criteria. All these limitations might have led some degree of bias in the research.

## **5.5 Areas for Further Research**

Apart from the research topic, there are several other interesting themes arising from the study that worth further researching. One interesting area is the participants' perception about this kind of citizen science project. Though the study has more or less involved the participants' perspective through questionnaires. As they were only provided with limited choices to choose from, their opinions could not be fully expressed. But in fact, their insights are important for revealing practical problems and improving the project. Thus, further research could try to involve more in-depth insights from participants through direct interviews. The second interesting area is the research part of the project. To examine the effectiveness of the data collection, it is necessary to look into the overall research outcomes and the results of data collection in different regions. This could be done through interviews with the data managers and the researchers who use those data to do research. Besides, as the operation of OPAL relies largely on its informal network, it is also interesting to get some insights from the informal partners like schools and other organisations. In this way, it is possible to examine the wider influence of OPAL and see whether the project could be sustained beyond the formal network. Furthermore, as the second phase of OPAL will come to an end this year, it would also be interesting to do some further research on its first and next funding period, thus to examine the changes of the citizen science project over time.

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## **Appendices**

- **Appendix A:** Interview Question Examples
- **Appendix B:** Questionnaire
- **Appendix C:** Full Data Set for Questionnaire Results

## **Appendix A: Interview Question Examples**

### **Coordinator**

1. How long have you been involved in the OPAL project?
2. How do you balance your role between OPAL and the partner organisation?
3. What role do the partner organizations play in the project?
4. How do you connect with each other?
5. Which roles do you think are most important for the project?
6. How do you get people to know about the project?
7. What benefits could volunteers gain from participation?
8. How do you combine or balance public interest and scientific interest in the CS projects?
9. What methods or tools are used to facilitate participation?
10. Is there an online platform for participants to share their opinions? Do you get feedback from the participants regularly?
11. Is it difficult to keep continuous or long-term engagement in the project?
12. Are all the partners responsible for the data analysis of their parts? Or they all submit the data to a certain organization?
13. Do you need to guarantee the reliability of the data collected by volunteers?
14. Is funding important for the project? Which part of the project requires the most funding?
15. Do you need to keep looking for additional funding to support the projects?
16. From your experience, what do you think are most important principles for running an effective CS projects?



## **Project Leader**

1. How long have you been involved in the OPAL project?
2. How do you balance your role between OPAL and the partner organisation?
3. Could you tell me the difference between your role as a project leader and the community scientists in the OPAL project?
4. Why would the partner organisation join the OPAL network?
5. What would be the mutual benefits for both sides?
6. Is the existing network and resources of the partner organisation helpful for OPAL?
7. Is the OPAL project helpful for the partner organisation?
8. What do you think would be the main advantages of the current type of partnership?
9. Is there any aspects need to be strengthened in the current collaboration?
10. Could you tell me about how the OPAL funding is used?
11. Is the funding enough for the operating the project?
12. Is funding important for sustaining the project?
13. Do you think the current partnership is sustainable?
14. If the funding finish, would it affect the partnership?
15. Will you look for other funding to support this kind of project?
16. What do you think are the main difficulties in maintaining the sustainable running of the project?

## **Community Scientist**

1. How long have you been working in the OPAL project?
2. Are you mainly working with OPAL or the partner organisation?
3. Could you tell me what role does the partner organisation play in the OPAL network?
4. What would be the mutual benefits for both sides?
5. Is the existing network or resources of the partner organisation helpful for OPAL?
6. Is the OPAL project helpful for the partner organisation?
7. What are the main advantages of this partnership?
8. Is there aspects need to be strengthened in the cooperation?
9. Could you share with me your main duties as a community scientist? And which area are you responsible for?
10. Have you met your outreach target? Are you keep approaching more volunteers?
11. Do you need help in delivering those survey? Are volunteers like community champions important for the project?
12. Do you need to communicate with other partner groups regularly?
13. How do you target participation groups?
14. Which group are you mainly working with? Which group is more approachable?
15. What kind of activities do you hold?
16. What do you think about the survey design?
17. How are volunteers engaged in the surveys? How frequently do they need to do the surveys (or one-off)?
18. What benefits could volunteers gain from participation?
19. Do you use any online methods (like social media) to promote the project?

20. Do you get feedback from the participants regularly?
21. Does the project mainly rely on short-term or long-term engagement? Is it difficult to keep long-term engagement in the project?
22. Do you need to guarantee whether the volunteers have submitted the data or not?
23. Is funding important for the project?
24. Do you know how the OPAL funding is used? Which part of the project requires most funding?
25. What do you think are the main difficulties in maintaining the sustainable running of the project??
26. What do you think are most important principles for running an effective CS projects?  
Do you have some tricks in public engagement?

## **Community Champion**

1. How did you start your story with OPAL?
2. Could you share with me your duties in OPAL?
3. Which surveys are you involved in?
4. Which group are you mainly working with? Which group is easier to work with?
5. How do you get people to participate in the project? Do you need to contact those group or the community scientists will do that before you approach them?
6. How do you feel like working with participants?
7. What do you think about the survey design?
8. Is there anything need to be improved from those surveys?
9. What method do you use to promote the project? Do you use social media?
10. Do you get feedback from the participants regularly?
11. How are volunteers engaged in the surveys? How frequently do they need to do the surveys (or one-off)?
12. Does the project rely on short-term or long-term engagement? Is it difficult to keep long-term engagement in the project?
13. Do the participants need to submit the data by themselves?
14. What benefit do you think they could gain from the surveys?
15. Do you have some tricks in public engagement?
16. Is there any interesting stories you could share with me?

## Appendix B: Questionnaire

### 1. What is your age?

☐ Under 18    ☐ 18-24    ☐ 25-39    ☐ 40-59    ☐ 60 and above

### 2. Is it your first time participating in this kind of activity?

☐ Yes    ☐ No

### 3. Do you know about the OPAL project?

☐ Familiar with    ☐ Know a bit    ☐ Haven't heard before

### 4. How do you know about the activity?

☐ Online    ☐ From friends & colleagues    ☐ From other events    Other \_\_\_\_\_

### 5. What interests you to participate in the activity? (Multi-choice)

☐ The topic    ☐ Being outdoor & close to nature    ☐ Learning something new  
☐ Getting involved in science    Other \_\_\_\_\_

### 6. What do you think about the instruction of the survey? (Multi-choice)

☐ Clear    ☐ Easy to follow    ☐ Confusing    ☐ Complicated    Other \_\_\_\_\_

### 7. What do you think about the survey?

☐ Interesting    ☐ Boring    ☐ Nothing special

### 8. What do you gain from the activity? (Multi-choice)

☐ Knowledge    ☐ Skill    ☐ Sense of achievement    ☐ Environmental awareness  
☐ Relaxation    Other \_\_\_\_\_

### 9. Do you think your contribution could make a difference to science and nature?

☐ Yes    ☐ Maybe    ☐ It doesn't matter    ☐ I don't think so

### 10. Would you consider doing the same survey again in your spare time?

☐ Yes    ☐ Maybe    ☐ Probably not    ☐ No

**11. Would you like to join similar kind of activities again in the future?**

☐ Yes    ☐ Maybe    ☐ Probably not    ☐ No

**12. Do you find the experience useful for your life?**

☐ Yes    ☐ No    ☐ Not sure yet

▪ **Your general impression about the activity:**

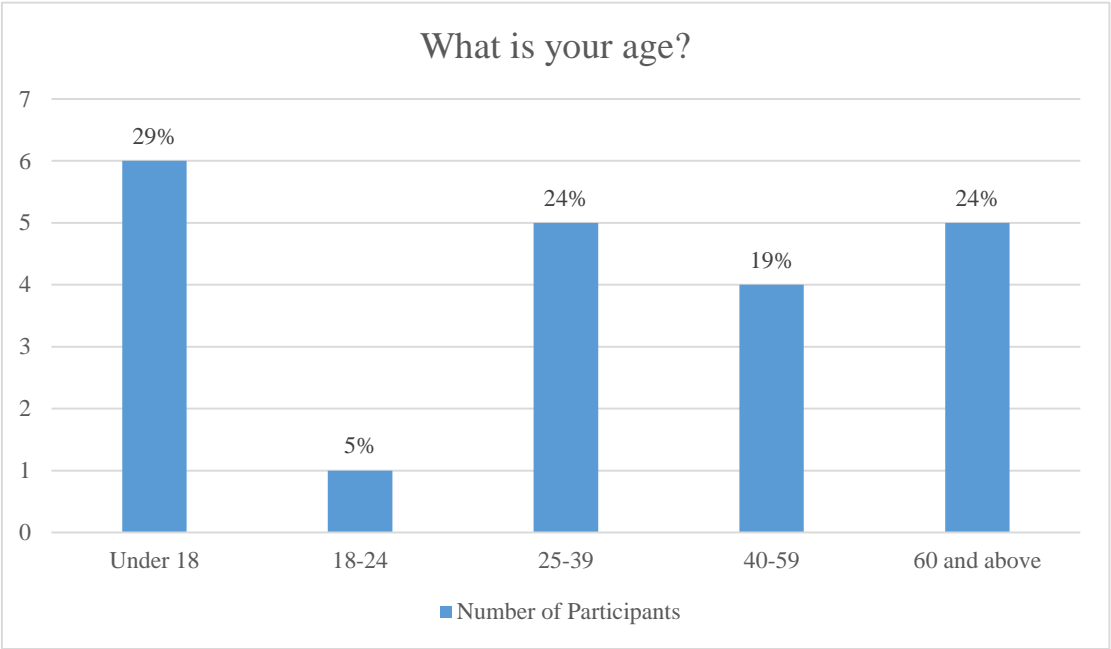
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▪ **Your suggestions:**

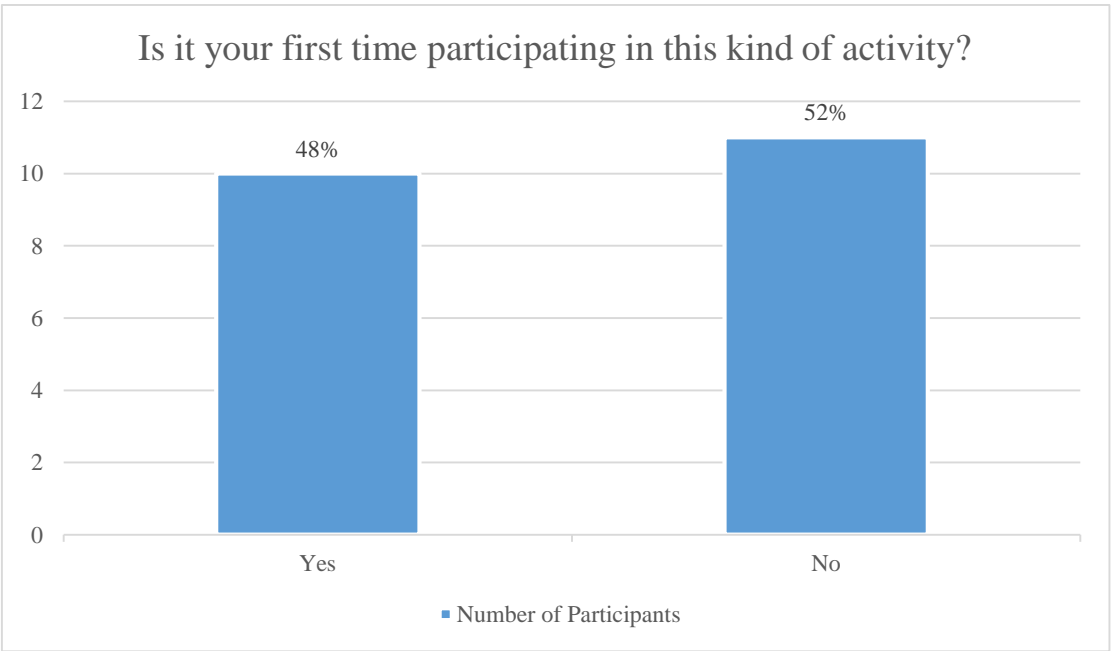
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**Appendix C: Full Data Set of Questionnaire Results**

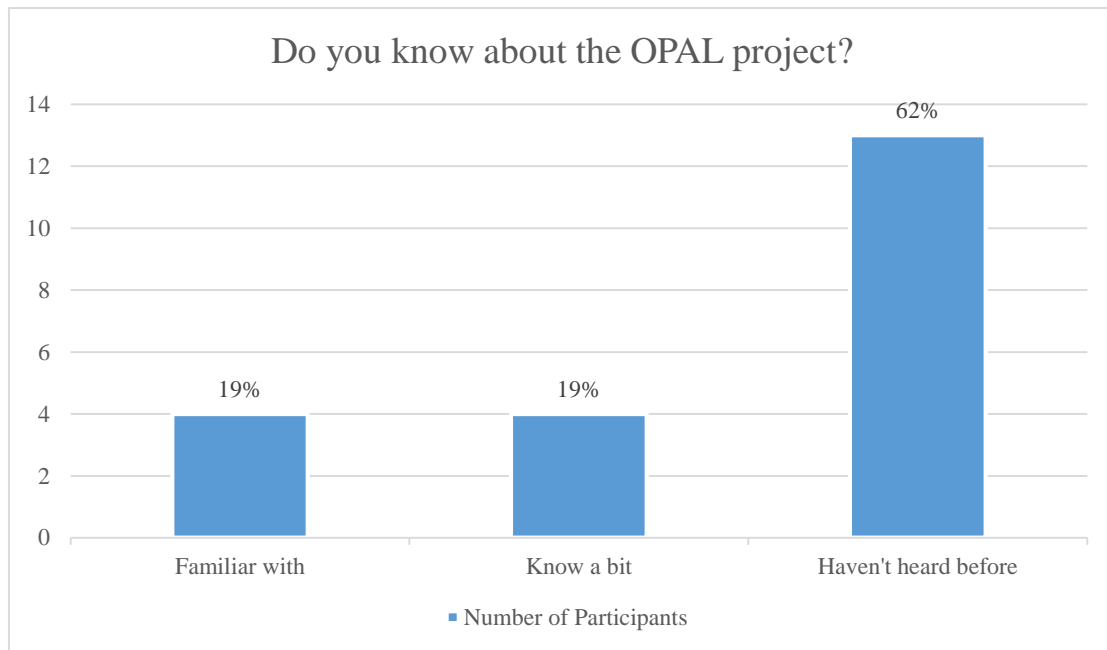
**1. What is your age?**



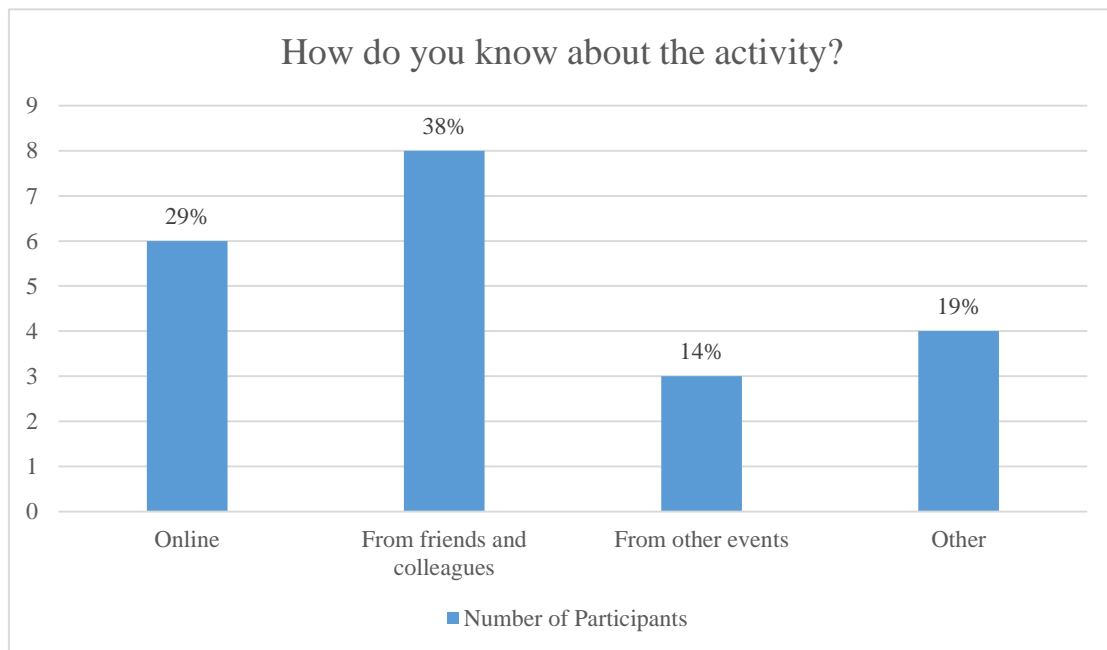
**2. Is it your first time participating in this kind of activity?**



### 3. Do you know about the OPAL project?

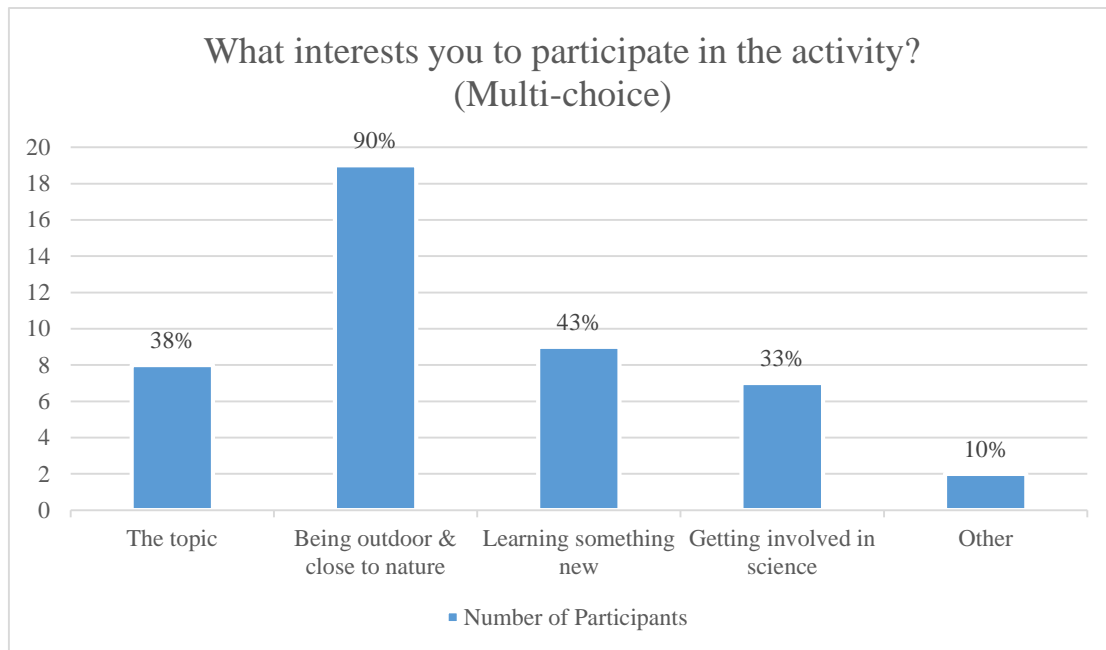


### 4. How do you know about the activity?

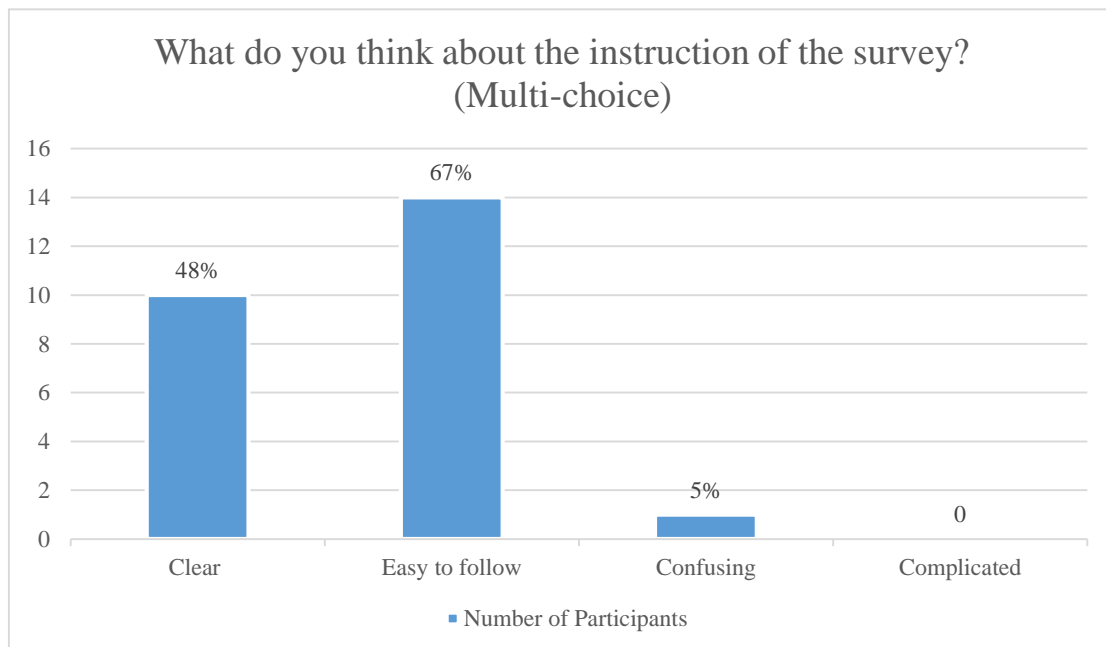




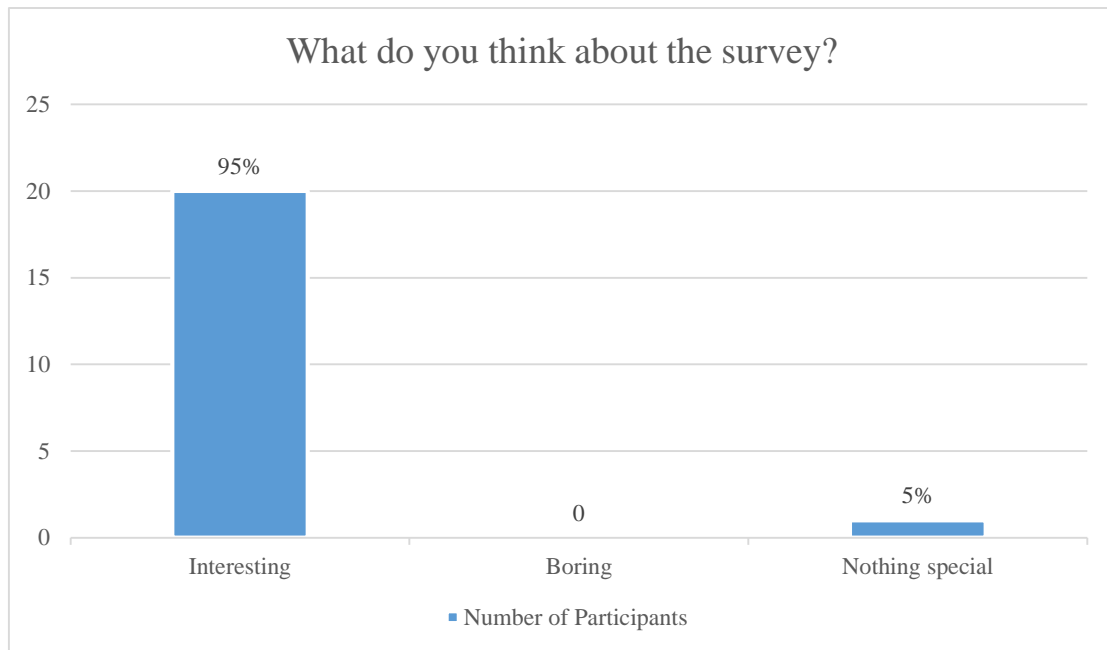
**5. What interests you to participate in the activity? (Multi-choice)**



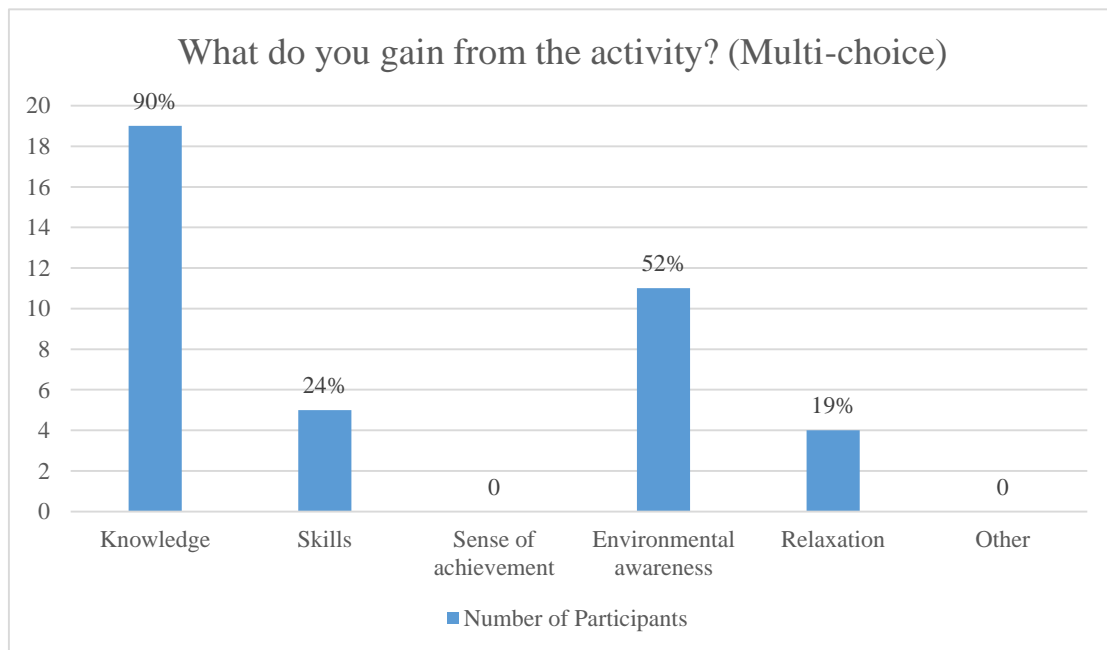
**6. What do you think about the instruction of the survey? (Multi-choice)**



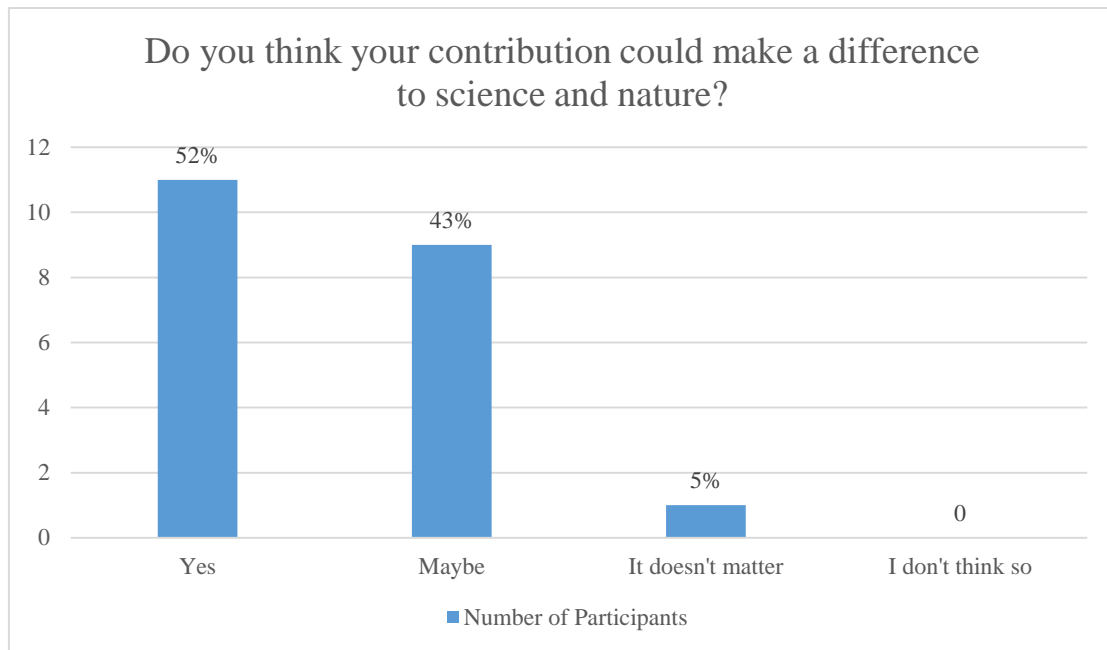
## 7. What do you think about the survey?



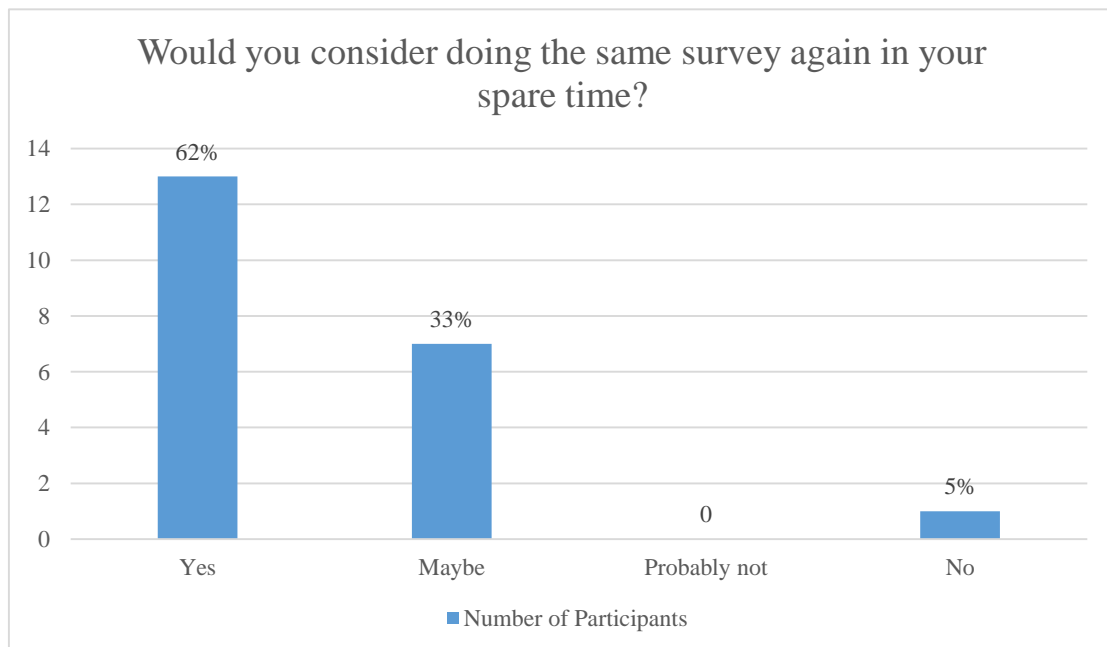
## 8. What do you gain from the activity? (Multi-choice)



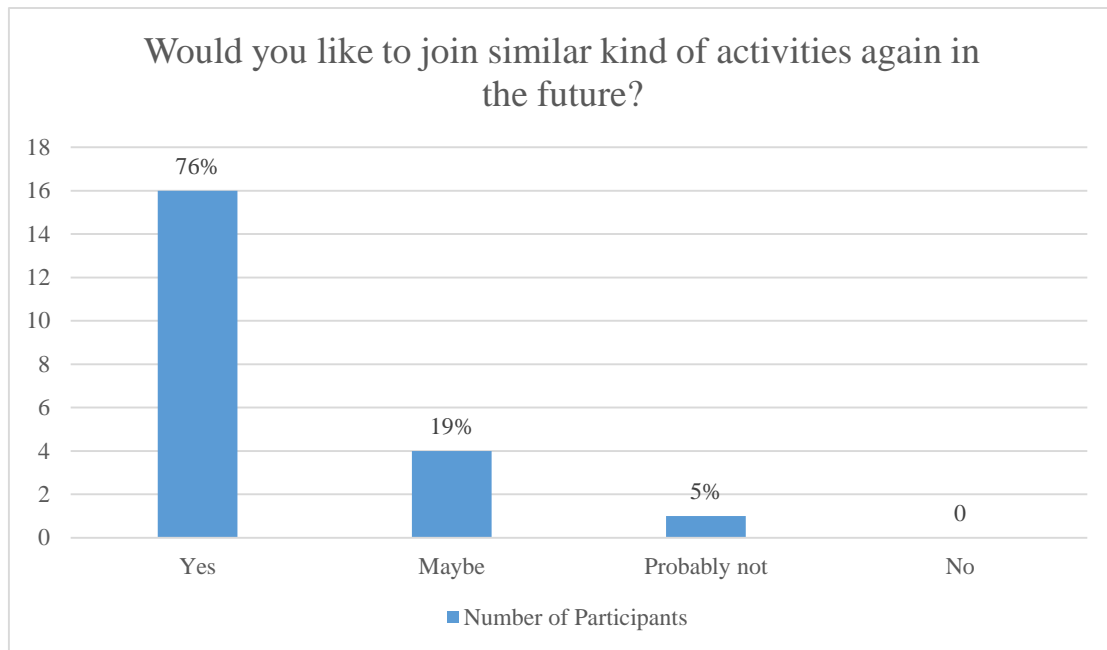
**9. Do you think your contribution could make a difference to science and nature?**



**10. Would you consider doing the same survey again in your spare time?**



**11. Would you like to join similar kind of activities again in the future?**



**12. Do you find the experience useful for your life?**

