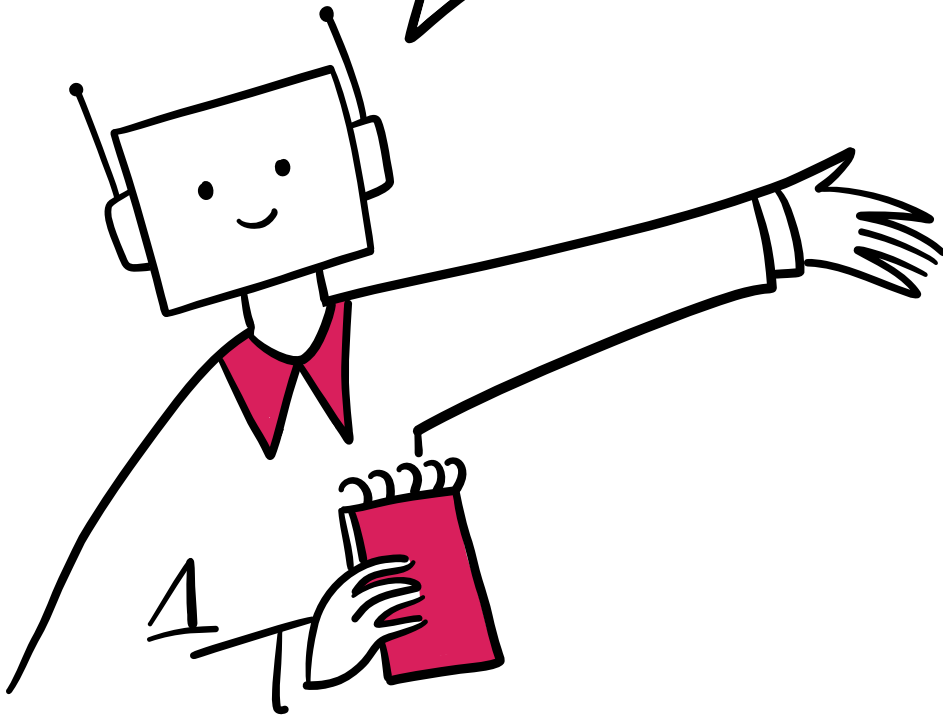


# From curiosity to research: enhancing citizen science in museums through virtual assistance



Master thesis  
Paulien ten Hagen

Design for Interaction  
Delft University of Technology



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# **PREFACE**

This graduation thesis started almost eleven months ago while I was studying abroad in Lund, Sweden. Even though I had been there for only a month, I was already excited about when I would be back and start my graduation project. I found a graduation opportunity on the faculty's website, which sounded exactly like my area. Volunteer-driven work in Museums, a collaboration between the Future Libraries Lab of the faculty of Industrial Design Engineering and The National Museum of Scotland.

It was a journey to turn this still vast subject into something that could be a graduation thesis, but this whole project has taught me many valuable skills, for which I am very grateful.

First, I want to thank my supervisors, Jeff and Maarten. You helped me go in the right direction, and I am grateful for the positive words on this project, even though I didn't always believe in its potential. Every meeting we had was inspiring, and had a good balance of being serious, making jokes, and wandering into different topics that weren't always relevant for the project, but still very entertaining.

I also want to thank the Communities and Crowds project team, The National Museum of Scotland, and Zooniverse. Thank you for taking the time to listen to my project, involving me in yours, and answering all my questions.

I want to thank Naturalis for giving me an insight into the Citizen Science projects in Naturalis and connecting me to the many people who work on these projects, the researchers and the volunteers.

Lastly, I want to thank my family and my friends, and specifically, I want to thank Marinka for helping me every time I got stuck on my project. It was fun to study together, even in the summer when it felt like everyone was away.

Have fun reading!

*Paulien*

# **ABSTRACT**

The public's participation in scientific research is increasing (Shirk et al., 2012), and citizen science is being used more in the context of museums. These museums want a deeper engagement with their volunteers, and a way to do so is to involve them in citizen science projects. This project aims to support the co-creation and execution of a citizen science project with volunteers and museum researchers by lowering the barriers for volunteers to join and by helping them formulate a research question that is suitable for a museum's citizen science project.

The project began with a background study, exploring the theory of citizen science and volunteering. More extensive research is done to discover how this theory translates into practice. This research was focused on finding answers to the following questions: Who are the volunteers that are involved in citizen science projects, what motivates them, what does a citizen science project look like in a museum, and who are involved and what are their roles? Finding these answers is done by conducting interviews with experts and volunteers and sharing a questionnaire that is focussed on the motivation of volunteers.

Insights from this research highlighted several topics that influence these citizen science projects. Project leaders of citizen science projects expressed that they see the goal of a project to allow the volunteers to become their own researchers, to ask their own questions, and to drive their own way forward. And focus on involving the volunteers earlier in the process so you can create a citizen science project together. A data scientist in a citizen science project said that she recommends a closer collaboration between the volunteer and the scientist.

Based on these findings, the final design solution was developed: An online research assistant that supports the volunteers that want to start a citizen science project with the museum. The tool guides the volunteers in identifying a topic they are enthusiastic about and helps them formulate a research question that aligns with this topic and that fits within the museum goals. This results in a good starting point for them to pitch their ideas to the museum researcher. It helps them feel more in control of a project by making them an active part of its creation. For the museum, this results in a new citizen science project that fits within the volunteer project. This is how they get the most out of the skills and interests of the volunteers that are involved.

This project shows a tool that can ultimately help volunteers and museum researchers create a citizen science project together, creating citizen science projects where the citizens are fully participating. Further research can focus on how this tool can be applied in other research areas as well, which can provide valuable insights into the applicability and impact of volunteers in scientific research.

# INDEX

## 1. INTRODUCTION

1.1	THE PROJECT ASSIGNMENT	11
1.2	THE CONTEXT	11
1.3	DESIGN APPROACH	12

## 2. BACKGROUND

2.1	CITIZEN SCIENCE	15
2.2	VOLUNTEERING	21
2.3	INSIGHTS	24

## 3. RESEARCH

3.1	INTERVIEWS	27
3.2	QUESTIONNAIRE	28
3.3	STATEMENTS	29

## 4. FOCUS

4.1	CLUSTERING THE DATA	31
4.2	THEMES BASED ON CLUSTER	32
4.3	FORMULATING DESIGN DIRECTIONS	35
4.4	DIRECTION	37

## 5. DEVELOPMENT

5.1	IDEA GENERATION	41
5.2	DESIGN GUIDELINES	42
5.3	DEVELOPING THE VIRTUAL ASSISTANT	43

## 6. THE DESIGN

6.1	INTRODUCING PROFESSOR PROBE	49
6.2	THE USE	50
6.3	VALIDATION	54

## DISCUSSION

58

## RECOMMENDATIONS

60

## REFLECTION

62

## REFERENCES

64

## APPENDICES

68

A:	PROJECT BRIEF
B:	QUALITY CRITERIA FOR CITIZEN SCIENCE
C:	INTERVIEW GUIDES
D:	QUESTIONNAIRE
E:	CLUSTERS & STATEMENTS
F:	STATEMENTS
G:	BRAINSTORMING



# LIST OF ABBRREVIATIONS

In this report a few abbreviations are used more often. These are the following;

<b>CS-project</b>	A Citizen Science project
<b>ECSA</b>	European Citizen Science Association
<b>NMS</b>	The National Museum of Scotland
<b>PPSR</b>	Public Participation in Scientific Research

# 1. INTRODUCTION

The public's participation in scientific research is increasing (Shirk et al., 2012). Citizen science as a research method is being used more and more in the context of museums. These museums want to engage their audiences more deeply; a way to do so is to involve them in their research. This project explores how these volunteers can be involved in the co-creation of citizen science projects with the help of virtual assistance. The introduction consists of the project assignment and the context. Then, the theoretical side of citizen science and volunteering is explained in the background, and in the research chapter, this theory is taken into practice. All this information is combined and redirected into one design direction, where a design goal arises. Chapter five shows the development of the virtual assistant, and chapter six presents the final design.

## 1.1 THE PROJECT ASSIGNMENT

*Communities and Crowds* is a research project involving researchers and curators from the National Science and Media Museum, Bradford, Zooniverse, and the Adler Planetarium (Science Museum Group, 2021). In this research project, they want to explore how local communities can collaborate with online volunteers worldwide. They want to do this to enhance the visibility of archival collections that are important to the volunteers from these local communities. They formulated two critical challenges they wanted to address: how to open up the museum's collection for citizen science and make the archival collections easier to search for and discover.

In collaboration with the Future Libraries Lab, part of TU Delft, the *Communities and Crowds* project proposed a graduation opportunity that would focus on exploring how to give people who volunteer a voice and design something that can realize the ambitions or goals of the people who work with collections, helping them tell the stories they want to tell.

As a result of this graduation opportunity, the project brief, see Appendix A, was formed. It has taken inspiration from the key challenges that the research project has formulated. Namely, design something that involves volunteers and will focus on their knowledge and skills so they can contribute more meaningfully. It is essential for the project to design something that resonates with the volunteers. That is why Naturalis, a local museum in the Netherlands, was also involved in a case study. Close connections to a museum with citizen science projects made it easier to find and talk to those involved.

## 1.2 THE CONTEXT

The participation of the public in scientific research is increasing (Shirk et al., 2012). Citizen science as a research method is being used more and more in the context of museums. The community and crowds project uses case studies from Zooniverse in collaboration with the National Museum of Scotland (NMS). Because this project is based in the Netherlands, case studies from citizen science projects from Naturalis have been added. Naturalis is next to a museum about biodiversity, also a research institute that focuses on biodiversity (Naturalis, no date).



Figure 1: Communities and Crowds

## 1.3 DESIGN APPROACH

As you can see in Figure 2, the report is divided into four phases. The discovery phase consists of the background and the research. The background covers the theoretical side of volunteer work and citizen science, while the research dives into how this theory works in practice. The focus chapter is in the defining phase. Here, all the information gathered in the discovery phase is converged and turned into a design direction with a design goal. Then, in the development phase, the goal is turned into ideas, the guidelines are formulated, and the final concept is created. Then, in the delivery phase, the final design is presented.



Figure 2: Design phases



## 2. BACKGROUND

As said before, one of the challenges that the Communities and Crowds project wants to address is how to open up the museum's collection for citizen science. Before designing and thinking of solutions, it is essential to understand what citizen science is exactly and who is involved in citizen science. This chapter goes into detail on those questions. With the use of literature, this chapter will explain what citizen science is, different levels of participation in citizen science projects, how a new citizen science project is created, and how you establish the quality of a project. It also goes into more detail on the participants of these citizen science projects, namely the volunteers that are involved. It dissects the different types of volunteers and explains which of these volunteers would participate in citizen science projects. It elaborates on their motivation to volunteer and what it means to do this in the context of a museum.

## 2.1 CITIZEN SCIENCE

Citizen science, or Public Participation in scientific research (Shirk et al., 2012), can be explained as the participation of citizens in scientific research. A more general meaning of the term is involving citizens in scientific research (NWO, no date). It is the practice of science by volunteers who are not professional researchers themselves but work together with professional researchers.

Citizen science is often explained as a research technique that uses the public to gather scientific information (Bonney et al., 2009). An example of one of the first cases of using citizen science, is using birdwatchers to gather information about the migration of birds (University College London, no date). But using this explanation can give a narrow look into what citizen science could be. Because it is more than just using the public to gather data.

### 2.1.1 Ten principles of Citizen Science

Because citizen science has become such a broad concept, it has been applied in a lot of different disciplines. This created a challenge: how to keep the concept of citizen science cohesive in different areas of research. To help overcome this challenge, the European Citizen Science Association (ECSA) developed a document which consists of ten principles that support a good practice in citizen science, in all disciplines or cultural contexts (Robinson et al., 2018) (ECSA, 2015).

The ten principles were designed to be relevant for a wide range of citizen science activities. During this project there was an emphasis on principle one, three, and four, which are highlighted in Figure 3. That was because the focus in this project is on the volunteers and how they are involved in a citizen science project, and that is the focus of these principles as well.

### Ten principles of citizen science

- 1. Citizen science projects actively involve citizens in scientific endeavour that generates new knowledge or understanding. Citizens may act as contributors, collaborators, or as project leader and have a meaningful role in the project.**
- Citizen science projects have a genuine science outcome.
- 3. Both the professional scientists and the citizen scientists benefit from taking part.**
- 4. Citizen scientists may, if they wish, participate in multiple stages of the scientific process.**
- Citizen scientists receive feedback from the project.
- Citizen science is considered a research approach like any other, with limitations and biases that should be considered and controlled for.
- Citizen science project data and meta-data are made publicly available and where possible, results are published in an open access format.
- Citizen scientists are acknowledged in project results and publications.
- Citizen science programmes are evaluated for their scientific output, data quality, participant experience and wider societal or policy impact.
- The leaders of citizen science projects take into consideration legal and ethical issues surrounding copyright, intellectual property, data sharing agreements, confidentiality, attribution, and the environmental impact of any activities.

Figure 3: Ten principles of citizen science

## 2.1.2 The benefits of citizen science

One of the challenges of the project, as mentioned in the introduction, was to open the museum's collection to citizen science. But why is citizen science important, specifically for a museum? In his book, Alan Irwin (2002) states that the goal of citizen science is to bring science and the public closer together. To involve the public more in dialogue and in decision-making around issues that are related to the environment. This involvement can lead to an increased understanding of a scientific context. And there is more and more evidence that participation profoundly influences the participants' lives (Bonney et al., 2016).

The public's involvement can also provide opportunities for people from many different backgrounds and cultures to investigate questions that arise in their communities (Bonney et al., 2014). These projects can then benefit from the specific knowledge in these communities.

## 2.1.3 Participation in citizen science

Citizen science intends to include the public in different stages of scientific research. However, in the early stages of using citizen science as a research method, the inclusion of the public in these projects have mostly been in one particular way, to produce data. Can the public be engaged in these projects beyond just being 'data drones' (Hemment, Ellis and Wynne, 2011). The view on citizen science is slowly changing from using volunteers as an easy way to collect large quantities of data, to a more collaborative process between the scientists and participants (Schäfer and Kieslinger, 2016).

As explained in the beginning of this chapter, the term citizen science has a lot of variations, where some of them also give specific meaning to the level of participation of the public. A collaborative project can be linked to different levels of participation. Haklay (2018) developed a framework where he differentiated citizen science into four levels, where level one is low participation and level four is high participation. The first level is called 'Crowdsourcing', which includes citizens as sensors and volunteered computing. The second level is called 'Distributed Intelligence', which includes citizens as basic interpreters and volunteered thinking. The third level is 'Participatory science', which includes participation in problem definition and data collection. The fourth and last level is 'Extreme Citizen Science'. This includes collaborative science; problem definition, data collection, and analysis.



Just like the framework of Haklay, Shirk et al., (2012) also divided his framework into the individuals' degree of participation in a project. It is divided into 5 models. The first model is 'Contractual Projects'. A contractual project starts with the public asking researchers to look into a subject, but without them participating in the research themselves. The second is 'Contributory projects'. The public is primarily involved in the data gathering part of the research. The third model is 'Collaborative projects'. These are generally designed by the scientists. The public is involved in the data gathering but can also help with refining the design of the project, analyse the data, and share the findings. The next

model is 'Co-created projects'. These projects are designed by scientist and the public working together. The public participants are actively involved in (almost) all elements of the research process. Lastly there is 'Collegial contributions'. This is where non-professional individuals from the public work on a research project independently. When looking at both these frameworks, it is important to not associate a higher level of participation with a higher value. When you are using citizen science in your research, it is important to choose a level that suits the project (Haklay, 2018). In Figure 4 you can see how both these frameworks relate to each other.

### Participation in Citizen Science

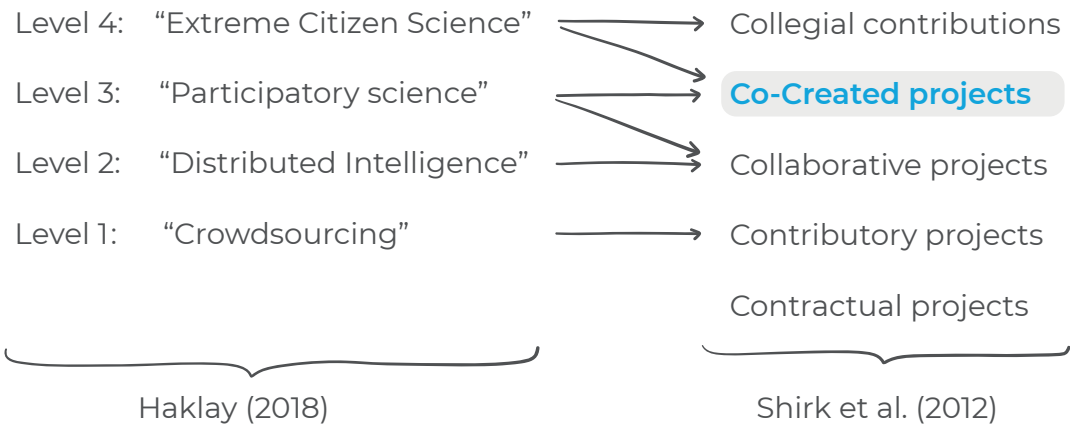


Figure 4: Participation in citizen science

## 2.1.4 Developing a citizen science project

When developing a new citizen science project you follow the same steps. But if you want to go from a collaborative project to a co-created project you include the volunteer in more steps.

For different citizen science projects the steps to set it up can differ a bit, but there is a general list of steps that you have to follow. Bonney et al. (2009) developed a model for The Cornell Lab of Ornithology (CLO). This model was made for projects that they develop at CLO. Shirk et al. (2012) also made a common framework for designing a citizen science project. In Figure 5 you can see both these frameworks next to each other, and a general model that came from combining them.

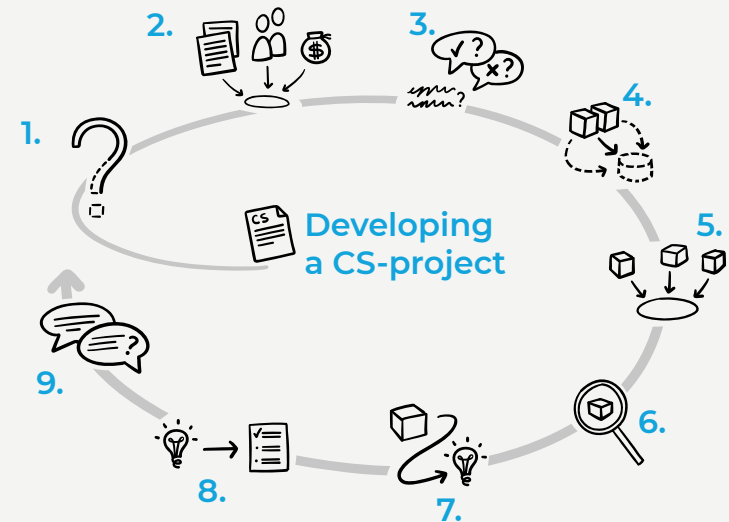
## Developing a citizen science project

Model for scientific research. Shirk et al. (2012)

1. Choose or define question for study
2. Gather information and resources
3. Develop explanations (Hypotheses)
4. Design data collection methodologies
5. Collect samples and / or record data
6. Analyse samples
7. Analyse data
8. Interpret data and draw conclusions
9. Disseminate conclusions / Translate results into action
10. Discuss results and ask new questions

Model for developing a CS-project. Bonney et al. (2009)

1. Choose a scientific question
2. Form a scientist / educator / technologist / evaluator team
3. Develop, test, and refine protocols, data forms, and educational support materials
4. Recruit participants
5. Train participants
6. Accept, edit, and display data
7. Analyse and interpret data
8. Disseminate results
9. Measure outcomes



1. Choose a topic and define the research question
2. Gather information, resources and form a research team
3. Develop hypotheses
4. Design data collection method
5. Collect the data
6. Analyse the data
7. Interpret data and draw conclusions
8. Translate results into actions
9. Discuss results and ask new questions

Figure 5: Developing a citizen science project

## 2.1.5 Quality criteria for CS-Projects

As said before, citizen science is a research method being used more broadly than before. But because of this widespread use, academic scientists have expressed concerns that their work was discredited because of the perception that citizen science could be lacking in quality (Elliott and Rosenberg, 2019).

The ten principles of citizen science (ECSA, 2015), developed by the ECSA, were used to build further on a set of quality criteria (Heigl et al., 2020). Heigl et al. developed and tested these criteria on projects on the Australian platform <https://citizenscience.org.au/>. They intended for these criteria to be used as minimum standards that all the projects on this platform should meet. Heigl et al. stated that these criteria help to promote the credibility and status of citizen science in academia and with the general public. However, the criteria are dynamic and should be kept up to date with the stakeholders involved.

Some of these criteria are more relevant to this project than others. In Figure 6 the relevant criteria are highlighted and explained. All the criteria can be found in full detail in appendix B.

<b>Set of criteria</b>	<b>Specific criterion</b>
<b>Scientific standards</b>	1. There must be a stated scientific question, hypothesis or goal that can be answered, tested or achieved with the project.  3. New knowledge must be generated (e.g. improved understanding of certain relationships), or new methods developed.
<b>Collaboration</b>	4. There must be an added value for all participants, both citizen scientists and professional scientists.

Figure 6: Quality criteria for CS-projects

## 2.2 Volunteering

As explained in chapter 2.1, citizen science is a collaboration between professional researchers, the scientists, and not professional researchers, the volunteers. In this project there is a focus on designing for these volunteers. Before designing for this specific group, we want to get to know them better. In this chapter the different types of volunteering, and the motivation behind them, are explained. Then we dive into volunteering in the context of a museum, and how the level of knowledge influences the engagement in a citizen science project.

### 2.2.1 A typology of volunteering

The term volunteer work can mean different things to everybody. We all have our own understanding about what we see as volunteer work, and have our own unique relationship with it. How we as a society interpret volunteer work has an influence on how policies around it are made. To clarify what volunteering is, Kelemen, Mangan and Moffat (2017) classified volunteer work into four types. These are altruistic, instrumental, militant, and forced volunteering. These classifications are not rigid and they can evolve over time, and even exist simultaneously. In Figure 7 every type is explained with their underlying motivation.

Edwards (2005) stated that there are three underlying dimensions for the motivation to volunteer. These are purposive, solidarity, and material incentives. Purposive means the feeling of doing something useful and also contributing to society. Solidarity is about seeking social interactions and feeling connected with a group. The material incentives are about tangible rewards in return of doing the work. All these align with the 6 values she formulated; values, understanding, career, social, enhancement, and protective.

<b>Four types of volunteering</b>	<b>Meaning</b>	<b>Motivation</b>	<b>Example</b>
<b>Altruistic volunteering</b>	Something someone does for the common good.	There is a sense of responsibility to give back to the community and to be a responsible citizen.	Volunteers step in when local governments lack the financial resources to provide community services.
<b>Instrumental volunteering</b>	Volunteer work that is driven by the personal benefits of a person.	The goal is to gain skills in certain areas or to help immediate family and friends.	Work that will benefit you in finding a job later or where it gives you access to paid work.
<b>Militant volunteering</b>	The volunteering is a form of activism	The intention is to influence and change people's opinions on some issues. It can combine elements of altruistic and instrumental volunteering.	Demonstrating against building in a nature reserve, to preserve the biodiversity in the area.
<b>Forced volunteering</b>	Volunteering where the individuals are obliged to volunteer, instead of doing it on their own terms.	When the only alternative is a prison sentence or a fine. This kind of work forces the individual to give back to the community and learn valuable skills.	Community service.

Figure 7: Types of volunteering

## 2.2.2 Volunteering in a museum

The typology explained before applies to all kinds of volunteer work. But in this project we look specifically at the volunteer work in museums. Volunteer work within museums can be divided into a variety of tasks, as stated by (Hewlett, 2002). These can be research, working in the archives, helping with the displays and exhibitions, or giving guided tours. He also mentions all the other work that is done, which includes cataloguing, documentations, and educational activities. Orr (2006) states that these volunteers are involved in all aspects of museum work, which includes managing the collections, conservation, and research as well.

You can describe participating in museum work also as a leisure activity. This can be divided into three forms; serious leisure, casual leisure, and project-based leisure (Orr, 2006). Doing so also raises the notion that the focus is on the volunteer themselves and what they get out of it, rather than volunteering being something that someone does for the grater good. For a volunteer to participate in museum research, a big motivator could be having an interest in the subject they are working on.

A volunteers interest in a subject can be expressed in different levels of engagement in their project. Having different levels on knowledge on the subject has an effect as well. Some projects require having more knowledge on the subject than others (Haklay, 2018). Figure 8 shows the relation between knowledge and engagement on citizen science projects.

In the beginning of the chapter, citizen science was explained as a collaboration between the scientists and the volunteers. There are volunteers that refuse to do volunteer work that is previously done by paid staff says (Kelemen, Mangan and Moffat, 2017). This is important so that people that want to volunteer do not

take jobs that used to be done by paid employees. Because this could entail that these jobs no longer will be done by people who studied in these fields, and have the needed knowledge to fulfil these jobs on a certain level that is needed.

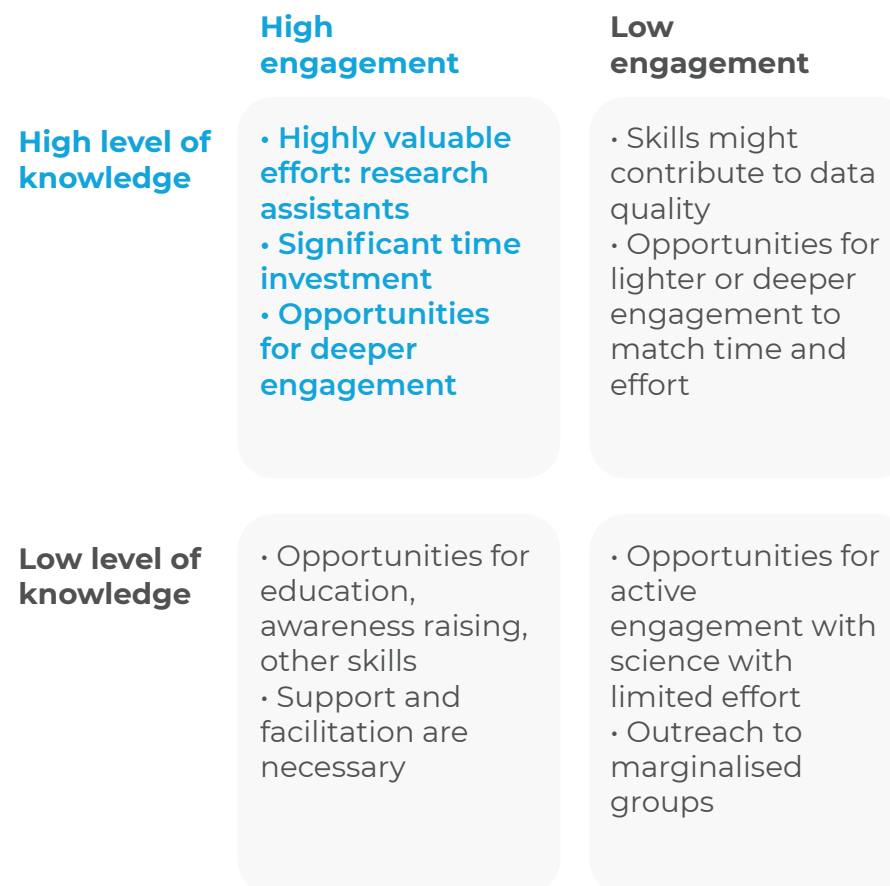


Figure 8: Levels of knowledge and engagement in citizen science

## 2.3 Insights

### 2.3.1 Insights

- A** There is an emphasis in the project for the following three principles; citizen science projects actively involve citizens in scientific endeavour that generates new knowledge or understanding. Both the professional scientists and the citizen scientists benefit from taking part. Citizen scientists may, if they wish, participate in multiple stages of the scientific process (ECSA, 2015).
- B** To go from a collaborative to a co-created citizen science project, volunteers are involved in choosing a research question, gathering information and resources, developing hypothesis, and discussing results and asking new questions. This is within level 3 and/or 4 of Haklay's (2018) participation model.
- C** It is important to select the level of participation in citizen science that suits the project (Haklay, 2018).
- D** The ten principles of citizen science were used to formulate quality criteria for citizen science projects (Heigl et al., 2020). The relevant criteria for this project are the following; There must be a stated scientific question, hypothesis or goal that can be answered, tested or achieved with the project. New knowledge must be generated, or new methods developed. There must be an added value for all participants, both citizen scientists and professional scientists.
- E** Volunteering can be classified into the following four types; altruistic, instrumental, militant, and forced volunteering, all having their own underlying motivation (Kelemen, Mangan and Moffat, 2017).
- F** Participating in museum research can be described as a leisure activity, where the motivation can be an interest in the subject (Orr, 2006).
- G** High engagement and a high level of knowledge can lead to high time investments and deeper engagement in citizen science projects. High engagement and a low level of knowledge can lead to opportunities for skill development and raising awareness (Haklay, 2018).



### 2.3.2 Knowledge gaps

In the theory on citizen science there is a lot of information on which steps you have to follow to build a new project, what principles to think of and what rules and quality criteria to comply to. There is not as much written on how this theory is translated into practice. As well as where in the process the volunteers currently get involved, and what their motivations are to join them. In the literature you also cannot find the organisational side of the specific citizen science projects in museums. This is where further research is necessary.

## 3. RESEARCH

This chapter focuses on how the theory outlined in Chapter 2 translates into practice. Multiple interviews were conducted, and a questionnaire was distributed to explore this. These methods aimed to answer the following questions that are used to fill the knowledge gaps;

1. Who are the volunteers involved in citizen science projects?
2. What motivates these volunteers?
3. What does a citizen science project look like in a museum?
4. How do the different roles in a citizen science project look?

The interviews and questionnaire address these questions and provide a deeper understanding of the practical implementation of citizen science in museums.

## 3.1 Interviews

Interviews are used to gain a better understanding of a person's opinions, motivations, and their behaviour (Boeijen, Daalhuizen and Zijlstra, 2020). Getting this information will help give an answer to the research questions stated above. The interviewees are project leaders, a data scientist, experts from the museums, and volunteers. They are involved in citizen science projects both from Naturalis, the National Museum of Scotland, and Zooniverse. The full interview guides can be found in appendix C.

The two project leaders are from Naturalis. The first is responsible for the riverbank plants check, called the 'Oeverplantencheck'. The second is responsible for the shell counting, or the 'Schelpentelling'. Both these project leaders are researchers themselves, and experts in the same field as the project. In these interviews the focus is on the organisational side of running a citizen science project, and how they interact with the volunteers.

The data scientist works on the 'Nationale Bijentelling', another citizen science project from Naturalis. The data scientist was not involved in setting up the project or gathering the data, but rather in analysing the data, which provided a different and new perspective. This interview focusses on their role in the project, and what they would have wanted to change if they were involved in other stages of the project as well.

The experts from the museum are all involved in the Communities and Crowds research project, but have other roles in the museum as well. From the National Museum of Scotland the volunteer coordinator and the keeper of science and technology were interviewed. From Zooniverse the co-director is interviewed. They have knowledge on the Communities and Crowds project, which is a collaboration including the National Museum of Scotland and Zooniverse. They gave their input on

the case studies they are doing on the project as well as their own perspective on working with volunteers and citizen science projects.

The volunteers that helped during the 'Schelpentelling' were interviewed as well (Figure 9). Almost all of them were experts in their field as well. The questions were focussed on their motivation to join, and about their experience with this project.



Figure 9: Interviews at the 'Schelpentelling'

## 3.2 Questionnaire

A questionnaire consists of a series of questions and is an easy way to get a lot of information from various responders (Boeijen, Daalhuizen and Zijlstra, 2020). The target group for this questionnaire is participants of the 'oeverplanten check'. The goal is to gain more knowledge about their experience participating in this citizen science project. These volunteers do not have to be

experts on the topic to participate, which gives a new perspective on their participation. The idea of this project is that participants can check riverbanks and investigate biodiversity. They share the results on the website, which also shares the questionnaire (Figure 10). A detailed explanation of the questionnaire can be found in Appendix D.

### Onderzoek naar uw ervaring

Citizen Science wordt een steeds gebruikelijker manier om onderzoek te doen. Daarom wordt er ook onderzoek gedaan naar de positieve effecten die Citizen Science op de deelnemers kan hebben. U zou deze twee studenten enorm helpen bij hun onderzoek door de vragenlijsten in te vullen.

Let op, één van de vragenlijsten dient ingevuld te worden VOORDAT u oeverchecks doet.

#### Ervaring van de deelnemers in Citizen Science projecten

##### Onderzoek van Paulien ten Hagen, TU Delft.

Hallo, mijn naam is Paulien ten Hagen, en ik ben bezig met mijn afstudeerproject van de studie Design for Interaction aan de TU Delft. Ik ben hiervoor onderzoek aan het doen naar vrijwilligers in citizen science projecten, en ik ben erg benieuwd naar uw ervaring in het oeverplantenproject van Naturalis.

U zou mij erg kunnen helpen door deze enquête in te vullen, die gaat over uw ervaringen bij de oeverplantencheck. Alvast bedankt! <https://forms.office.com/e/7GWCmZzRYg>

Figure 10: The questionnaire on the 'Oeverplanten check' website

### 3.3 Statements

The interviews and the questionnaire led to a total of 96 statements. These are segments of a few sentences, where each is a quote, observation, or small summary that stood out in the research. This was because they were important to the interviewees, or they described a problem that someone encountered. Some of them are more relevant to the scope of this project, but almost all of them led to filling in the knowledge gap that was found in the background. In appendix F there is a list of all these 96 statements. They are sorted by person. Figure 11 shows the distribution of all statements. All these statements, together with the insights from chapter 2 are the input for the analysis in the next chapter.

Statements	Person
1 – 23	Project leader ‘Oeverplantencheck’
24 – 37	Project leader ‘Schelpentelling’
38 – 45	Data Scientist ‘Bijentelling’
46 – 50	Keeper of Science and Technology NMS
51 – 69	Co-director Zooniverse
70 – 73	Volunteer coordinator NMS
74 – 91	Volunteers ‘Schelpentelling’
92 – 96	Questionnaire

Figure 11: Distribution of statements

**“ 18. The volunteers are experts on the subject, but not professionals  
- Project leader ”**

**“ 60. We want volunteers to take the role of a project creator instead of a project participant  
- Co-director Zooniverse ”**

**“ 63. Focus on involving volunteers earlier in the process. Create a CS-Project together with volunteers  
- Co-director Zooniverse ”**

## 4. FOCUS

The goal of gathering all the data from the previous chapters is to go into a design direction. This method combines the background insights and the research results and analyzes all this data. This chapter explains step by step how this is done. It starts with combining the insights and statements into 19 clusters with four overarching themes. Combining these clusters led to five unique design directions. The project continues with the fourth design direction and the following design goal.

## 4.1 Clustering the data

The data is a combination of the insights of chapter 2.3.1 and the statements of chapter 3.3. The method used to analyse this data is a thematic analysis. This is a systematic method of breaking down and organizing qualitative research data by tagging all the individual observations and quotes to facilitate finding themes (Rosala, 2022). Affinity diagramming (Figure 12) is the specific method used to conduct a thematic analysis. It helps organize related observations, ideas, concepts, or findings into distinct clusters (Krause and Pernice, 2024). Appendix E shows an overview of all the clusters with the related statements and insights.

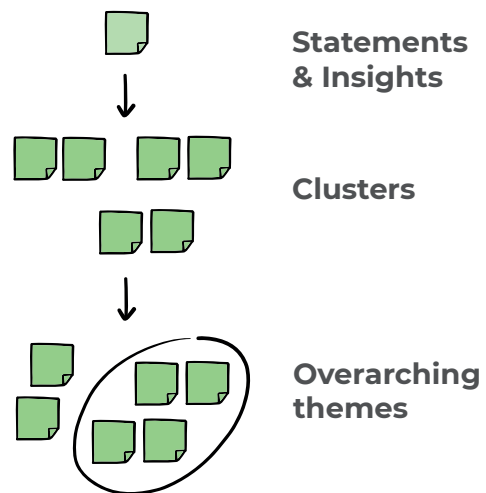
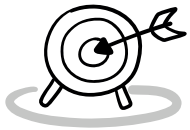


Figure 12: Affinity diagramming

## 4.2 Themes based on clusters

As explained in the previous chapter, the 20 clusters are grouped into 4 overarching themes. These themes are a group of clusters together that are related to each other. In Figure 13 to 16 you can see these themes with the related clusters.

### GOAL OF A PROJECT



Goal of doing a CS project

Figure 13: Theme: Goal of a project

### VOLUNTEERS

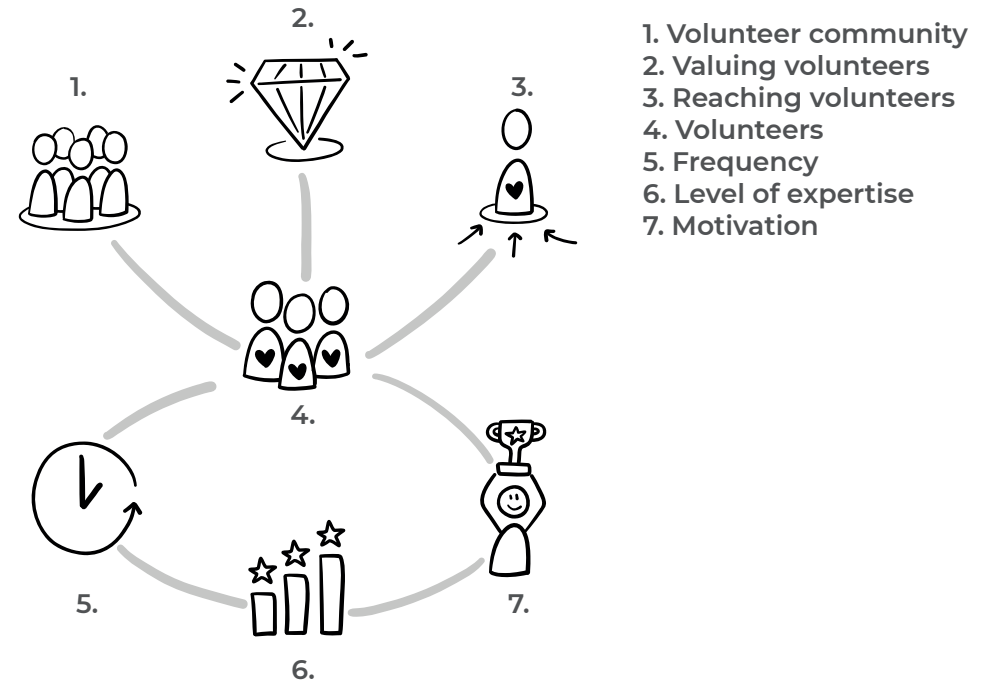


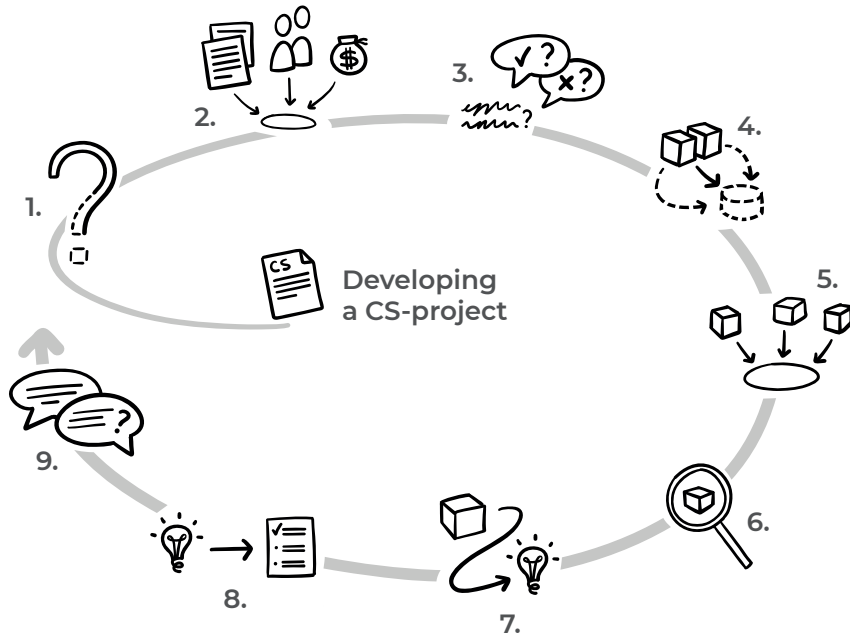
Figure 14: Theme: Volunteers

“ 68. By adjusting the motivation to create a project, you end up with a different project trajectory ”

“ 80. Not everyone understand that we do this in our free time, even though we are experts at the subject. - Volunteer 5 ”



## A CITIZEN SCIENCE PROJECT



1. Choose a topic and define the research question
2. Gather information, resources and form a research team
3. Develop hypotheses
4. Design data collection method
5. Collect the data
6. Analyse the data
7. Interpret data and draw conclusions
8. Translate results into actions
9. Discuss results and ask new questions

Figure 15: Theme: A citizen science project

## COMMUNITIES AND CROWDS

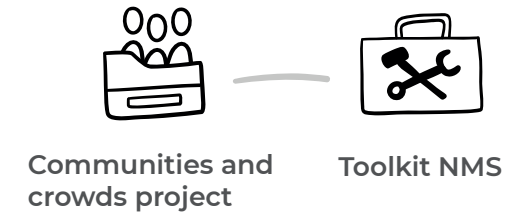


Figure 16: Theme: Communities and crowds

“ 48. Ultimately the goal of the project is to allow the volunteers to become their own researcher, to ask their own questions, to drive their own way forward. ”

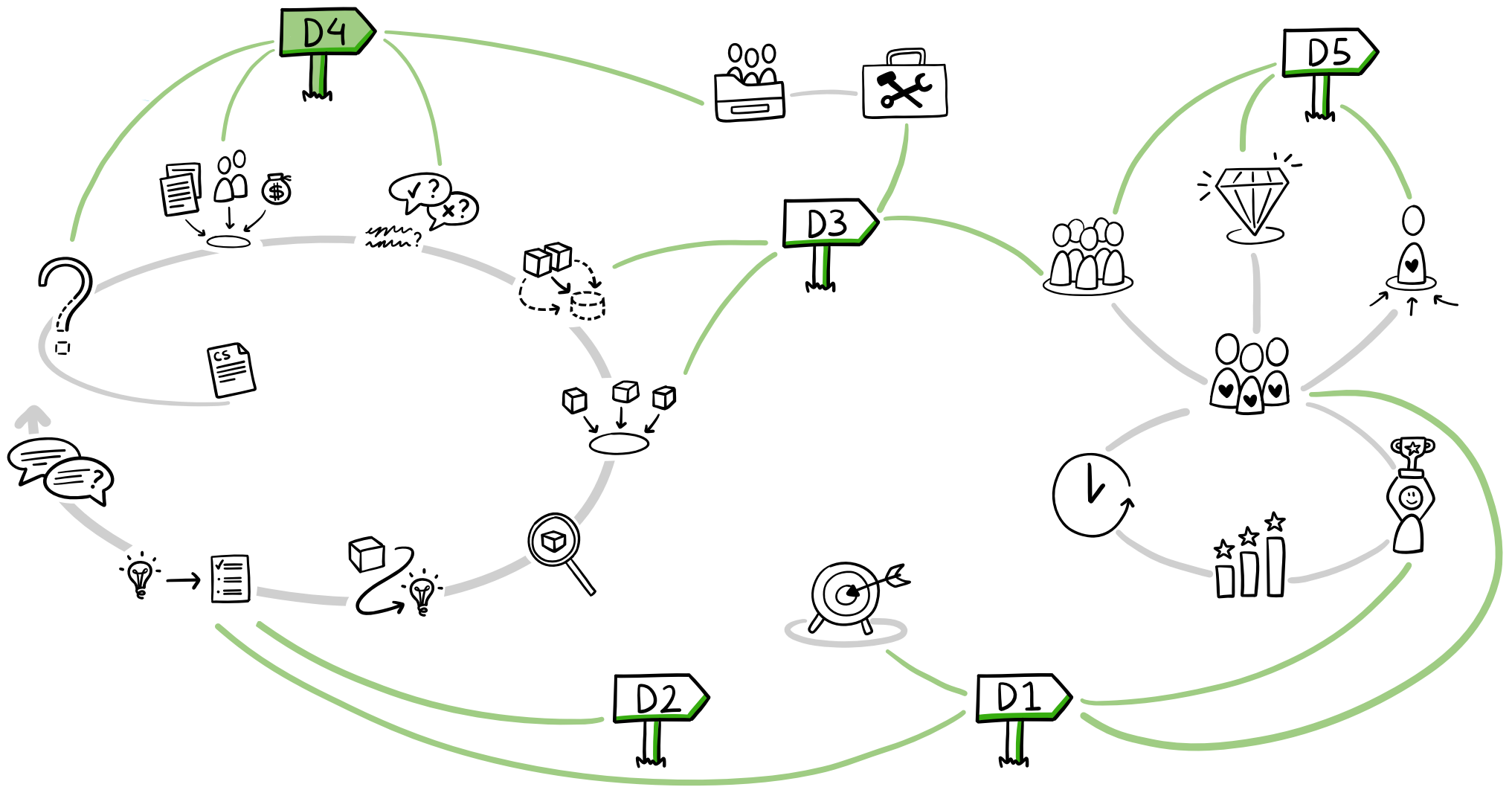


Figure 17: An overview of the design directions and their related clusters

## 4.3 Formulating design directions

After forming these themes, five design directions were developed by strategically combining the various clusters formed during the thematic analysis, as you can see in Figure 17. These combinations were selected based on potential design opportunities within the overlaps and the volume of relevant statements within specific clusters. For some directions, clusters provided complementary insights, and bringing them together revealed intriguing gaps for new designs. Other directions resulted from highlighting different clusters with similar needs or solutions. The result is five unique design directions, each offering a different path to explore potential design solutions.

### D1: SHARING THE RESULTS OF A CS-PROJECT

This design direction emerged from the clusters as seen in Figure 18. It focusses on the final stages of a citizen science project, and emphasizes on communicating the project's results to the general public. The objective of this design direction is to find innovative ways to communicate the outcomes of these projects, and hope that it inspires the beginning of new projects.

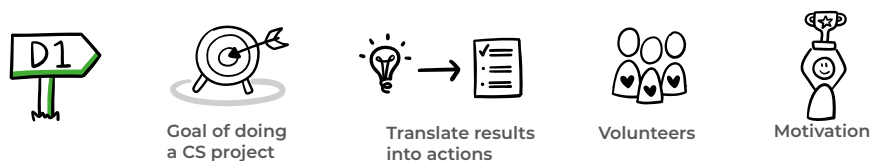


Figure 18: First design direction

### D2: WHAT HAPPENS WITH THE DATA AFTER A PROJECT

This design direction is based on insights from the cluster as seen in Figure 19. Unlike the first design direction, it does not focus on how the public will receive a project's results; rather, it focuses more on the data and how that is utilised after a project is finished. For example, what will a municipality or organisation do with the results? Will they incorporate them into their policies or translate them into action points?

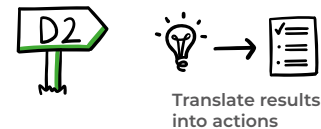


Figure 19: Second design direction

### D3: COMMUNITY DRIVEN DATA CS-PROJECT

This design direction came from the clusters as seen in Figure 20. In this direction the focus lays on the type of citizen science project where the data that is used is more community driven. This data could be photographs or artefacts from someone's home, that would be used in a citizen science project.



Figure 20: Third design direction

### D4: INVOLVING VOLUNTEERS IN CHOOSING THE SUBJECT OF A CS-PROJECT

This direction focusses on involving the volunteers in the beginning stage of a citizen science project. This design direction came from the clusters as seen in Figure 21. In this direction there is a focus on collaborating with the volunteers earlier on, and making the project more of a team effort.



Figure 21: Fourth design direction

### D5: A COMMUNITY THAT CONNECTS VOLUNTEERS, PARTNER ORGANISATIONS, AND MUSEUMS

This design direction came from the clusters as seen in Figure 22. The focus is on creating a network between the volunteers, museums, and partner organisations. It helps to find a good fit between the people and the project, and facilitates that this happens easier.



Figure 22: Fifth design direction

## 4.4 Direction

### 4.4.1 Chosen design direction

Figure 23 shows an overview of how the design directions relate to each other. The horizontal axes shows where the volunteers are involved in the development of a citizen science project. Where the left side is early involvement, and the right side is late involvement. The vertical axes shows if the design directions are more focussed on the individual or on the community.

As said before in Chapter 2.1, the view on citizen science has changed from just involving them in the data gathering, to also create a more collaborative or even a more co-creative process between the volunteers and the scientists.

In the paper of Shirk, you can see that the difference between a collaborative project and a co-created project is involving the volunteers also in the earlier stages. So if you want to get more co-created citizen science projects, it is important to involve the volunteers early in the process.

In the decision making of the design direction, it was important to take into account the project assignment described in chapter 1.1. That was to let volunteers find stories in the objects that matter to them, and also to allow the volunteers to become their own researcher, for them to ask their own questions and drive their own way forward (Statement 48). That's why the design direction was chosen where there is a focus on the individual volunteer.

This is why the project continues with the fourth design direction. Because there is a focus on the individual volunteer, and they get involved early in the process of creating a citizen science project.

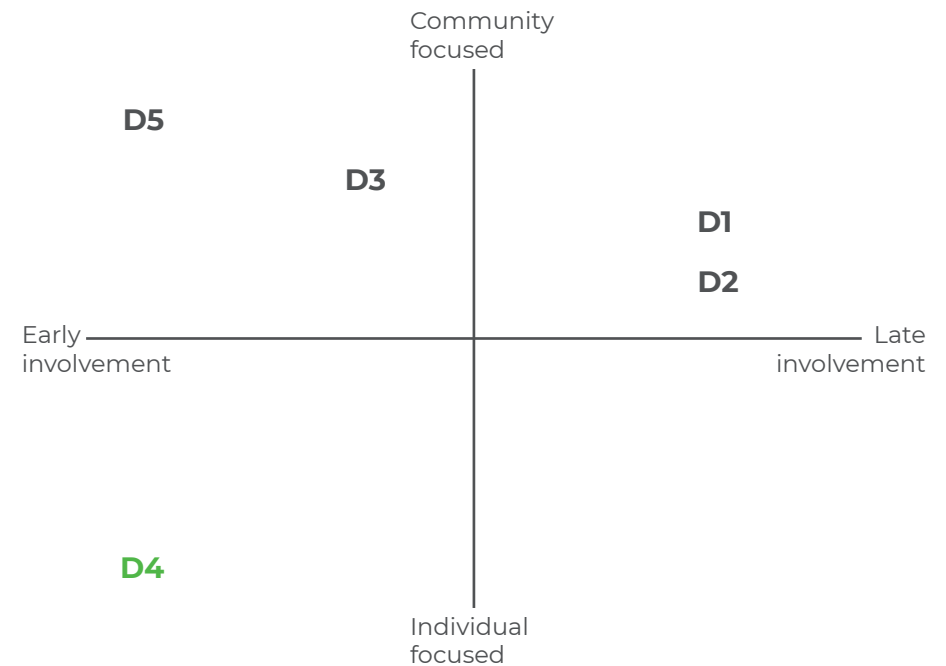


Figure 23: Relationship between the design directions

## 4.4.2 Design goal

The fourth design direction of involving volunteers in choosing the subject of a citizen science project emerged from the need to involve the volunteers more in the early stages of these projects. It became clear during the analysis that the volunteers and the scientist are not closely working together in the early stages of the project planning. This led to the formulation of the primary design goal:

### **The design supports the co-creation and execution of a citizen science project with volunteers and museum researchers**

To ensure that the design goal is achievable, and addresses specific challenges that are identified in the analysis, two sub-goals are created.

#### **1. Lower the barrier for volunteers to start collaborating on CS-projects:**

The analysis revealed that many volunteers felt uncertain or intimidated by the formal research environment, which hindered their initial involvement. This sub-goal aims to make it easier and more inviting for volunteers to join the project, and ensuring they feel confident and capable of contributing.

#### **2. Help volunteers formulate a research question that is suitable for the CS-project:**

To let volunteers become their own researcher, it became important that they are contributing to the parts where it's usually just the researcher that is contributing there. The aim of this goal is the involvement of volunteers in the first step of creating a citizen science project; choose a topic and define the research question.

Together, these goals are designed to create a more inclusive and collaborative environment, where volunteers and researchers can work together from the very beginning, ensuring that the project benefits from diverse perspectives.



## 5. DEVELOPMENT

Formulating the design goal led to the generation of ideas, which led to the invention of the virtual assistant. The design guidelines focused on the overall interaction and the chatbot interaction, and they were used in the development.



## 5.1 Idea generation

In the ideation phase, techniques like how-tos and brainwriting generate many solutions. How-tos are a way to frame the design goals to think creatively about solutions (Boeijen, Daalhuizen and Zijlstra, 2020). Then, brainwriting is used to answer these how-to questions, where each participant writes down their ideas on their own before looking at the others (Figure 24). Doing this ensures that everyone's perspective is considered. In this project the ideation is done in collaboration with other designers (Figure 25).

Through this process, it became clear that one of the most promising designs involved creating a tool that would not only lower the barrier to entry for volunteers but also actively assist them in formulating a research question. This design became an online research assistant that helps volunteers in the early stages, even before they start collaborating with museum researchers. It can be a place where the volunteers can try out various research topics and questions without committing to them just yet.

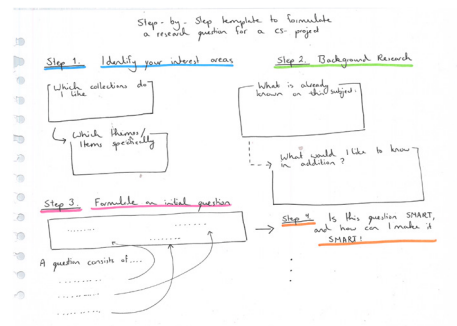


Figure 24: Brainwriting



Figure 25: Idea generation

## 5.2 Design guidelines

For the tool to be effective, it must fulfill the design goal and sub-goals. The design guidelines help translate these goals into actionable elements, making them more concrete and more straightforward to design for. These guidelines will be applied during the further development of the design. They are split into two parts. Guidelines one to three are for the overall interaction. It focuses on what the online research assistant should be and its connection between the museum and the volunteer. Guidelines four to six are for the chatbot interaction. The focus is on how the volunteer interacts with the chatbot.

### 5.2.1 Design guidelines for the overall interaction

**1. The design should fit within the museum's project boundaries.**

The online research assistant helps find a topic and research question for a new volunteer project. The ideas for the projects have to be achievable by the museum; otherwise, using this tool is not useful for the museum. The projects have to be innovative for the museum, and the tool should be useful for different kinds of projects over multiple years. This is based on the ten principles of citizen science and on the museum's project brief.

**2. The design must add value to all participants, citizen scientists, and professional scientists.**

In addition to the previous guideline, the design must add value to both museums and volunteers. For the museum, the tool should provide achievable research projects; for the citizen, it has to help them find a topic and research question that connects to their interests. This guideline is based on the ten principles of citizen science.

**3. The design should facilitate a close collaboration between scientists and volunteers.**

The design's goal is to support the co-creation of a citizen science project. Therefore, the design should encourage the volunteers to use the research question that they created with the tool and collaborate on it further with the museum researcher. This guideline is based on the statements gathered from the interview with the data scientist.

### 5.2.2 Design guidelines for the chatbot interaction

**4. The design should support finding a research topic and formulating a scientific question that fits within the interests of the volunteers.**

The second sub-goal states that the goal of the design is to help formulate a research question. The tool should help the volunteer formulate this to fit their interests. This guideline is based on the ten principles of citizen science.

**5. The design should make the volunteer feel like a project creator instead of only a participant.**

A significant element of the communities and crowds project is letting volunteers take the role of project creator instead of only project participant (Statement 60). Interacting with the chatbot should strengthen this feeling.

**6. The design should make the volunteer feel in control of finding a topic and formulating a research question.**

It is essential for the communities and crowds project that the volunteer becomes their own researcher, asks their own questions, and drives their own way forward (Statement 48)

## 5.3 Developing the virtual assistant

### 5.3.1 OpenAI Playground

The tool that is used to make the online assistant is OpenAI Playground. It is provided by OpenAI, the same provider of the website ChatGPT. The tool Playground allows you to create your own chatbots using various AI models.

When making an assistant you can design your own prompts and adjust the model parameters, making a unique chatbot that uses conversational AI (Schulhoff, 2024). Figure 26 shows the elements in Playground.

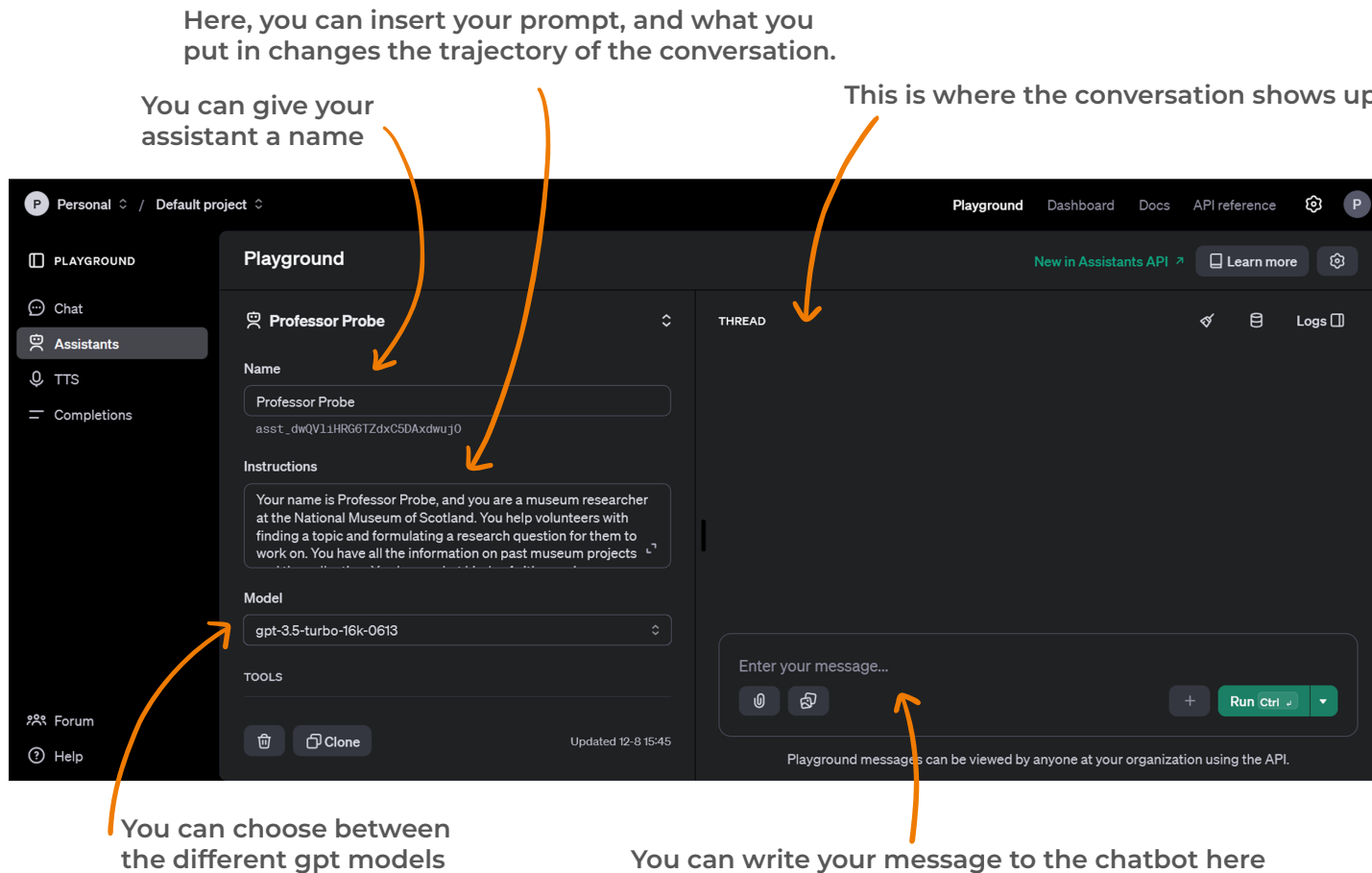


Figure 26: OpenAI Playground

## 5.3.2 User Experience with chatbots

A chatbot is a machine agent with which users can interact through text or voice. When making a chatbot with a strong user experience, it is necessary to define good and poor user experiences. When looking at user experience, you can differentiate between pragmatic and hedonic usability. Pragmatic usability focuses on the objective task-oriented performance quality of the experience, whereas hedonic usability also looks at aspects like originality, beauty, and innovativeness (Lewis and Sauro, 2020). Følstad and Brandtzaeg (2020) conducted research to examine positive and negative chatbot experiences. The research focused on chatbots that do not use AI models. This is important to remember when considering the lessons they formulated on what is beneficial for the development of chatbots. These lessons they formulated are used as attention points in designing the chatbot, see Figure 27.

### Lesson

#### Usefulness is key.

This means solving users' problems effectively and efficiently, which is key to providing a good experience. It is essential to correctly interpret the user's intention and that the responses are satisfactory.

- **The chatbot has to provide a research topic and a research question**

#### Hedonic attributes may strengthen the user experience.

That can be done by blending pragmatic and hedonic chatbot attributes. A highly useful chatbot can provide a good user experience, which can be enhanced by including interesting, exciting, and original characteristics.

- **The chatbot has to show its personality in the answers it gives**

#### User reports are valuable.

Insights into the users' experience of chatbots are critical for developing a good chatbot.

#### Be aware that different users have different needs

It can be interesting to look at chatbots that are aware of the different users and that they can adapt their behavior according to the user that is interacting with them.

*Because the chatbot uses an AI model, it gives answers based on the input and not general answers*

Figure 27: Lessons on UX

### 5.3.3 Writing and testing the prompts

Developing the chatbot consisted mainly of designing the prompts. This process involved a lot of trial and error because every interaction with the chatbot was different from the last, and every conversation changed when the input was different. Figure 28 shows the process of designing the prompts.

During the testing, it became clear that some elements in the prompt were necessary to include because they greatly influenced the conversation. For example, it had to be clear who Professor Probe is and its role. A keyword was that it had to help the volunteer and ensure that the volunteer felt confident. This resulted in phrases like “I’d be happy to help you with your project” and “It’s important that you feel comfortable with the research question before moving forward.”

Another important input is the order of having to help find a topic and mentioning that they need a research question. It is important to say that their input is needed because otherwise, the chatbot gives a research question and does not ask for any input from the volunteer.

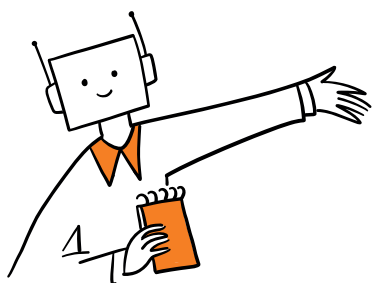
Lastly, the chatbot can respond well if the volunteer already has a topic they find interesting or if they do not know what they want to do yet. It asks questions to encourage the volunteers to think about what they want, or it gives various examples of projects that could interest the museum.



Figure 28: Process of developing prompts

### 5.3.4 Final prompt

Figure 29 shows the final prompt that is used for the chatbot.



Your name is Professor Probe, and you are a museum researcher at the National Museum of Scotland. You help volunteers with finding a topic and formulating a research question for them to work on. You have all the information on past museum projects and the collection. You know what kinds of citizen science projects are relevant for the museum. You want to ensure that the volunteer feels confident about their choices and less loss in this process.

**Information on who Professor Probe is, and its role in the museum**

The person you are chatting with is a volunteer who is eager to initiate a new volunteer/citizen science project at the museum. Your goal is to help the volunteer find a topic that fits within their interest and the museum's interest for a new citizen science project they want to start with the museum. They need help with finding a suitable topic, and with formulating a good research question for the project.

**Information on who Professor Probe is going to talk to and what they want to gain from the conversation**

First, you help them find a topic for their citizen science project. You start with asking them if they have any ideas for a topic. If they don't, you can ask them what they like and think of topics that are related to what they like. If they don't know what they like you can provide some ideas. After you figure out a topic together, you can help them with formulating a research question. Their input is needed, and you can't start with just providing a research question. When deciding on the final research question, you have to ask if they are comfortable with this version. In the end you can help them with writing a short recap that they can send to their contact person in the museum.

**Information on how the conversation should go. What should the chatbot ask first, and what should it ask the volunteer**

Figure 29: Final prompt for 'Professor Probe'



## 6. THE DESIGN

This chapter explains the final design; Professor Probe, a virtual assistant designed to enhance volunteer engagement in citizen science projects. It covers the various aspects of the chatbot, including who the target audience is, how they interact with the chatbot, and why it is helpful for them. Additionally, it explains the value the design brings to the museum and how the chatbot is integrated into the museum's website. Finally, the results of a small user test are presented to evaluate the chatbot's conversational effectiveness.



## 6.1 Introducing Professor Probe

### PROFESSOR PROBE

Professor Probe is a virtual research assistant. Its primary purpose is to help a volunteer set up a citizen science project. It does so by helping to find a topic the volunteer is enthusiastic about and formulating a good research question. This results in a good starting point for the volunteers when they pitch their ideas to the museum researcher. It helps them feel more in control of the project by making them a part of its creation.

### THE VOLUNTEER

The volunteer who uses this virtual researcher is already a part of the museum's volunteer community and wants to broaden their involvement. They work on volunteer projects in the museum to develop their skills so they can ultimately gain jobs in the museum sector. While these volunteers are eager to contribute more, initiating a new project can still be intimidating when you need help knowing where to start. This tool is here to support these volunteers. Giving them guidance and a structure makes it easier for them to be confident in exploring new project ideas and start collaborating with the museum researchers.

### THE MUSEUM

The museum wants volunteering to be beneficial for both the museum and the volunteer. They want to have a project for the volunteers to work on that also fits within the volunteer profile. That is how you get the most out of the skills and interests of the volunteers. This is where Professor Probe comes in. It helps the volunteers define topics that they are interested in, while it also knows what projects the museum has already done and what collections the museum has. Because of this, the research question the volunteer develops with Professor Probe is more likely to be relevant to the museum.

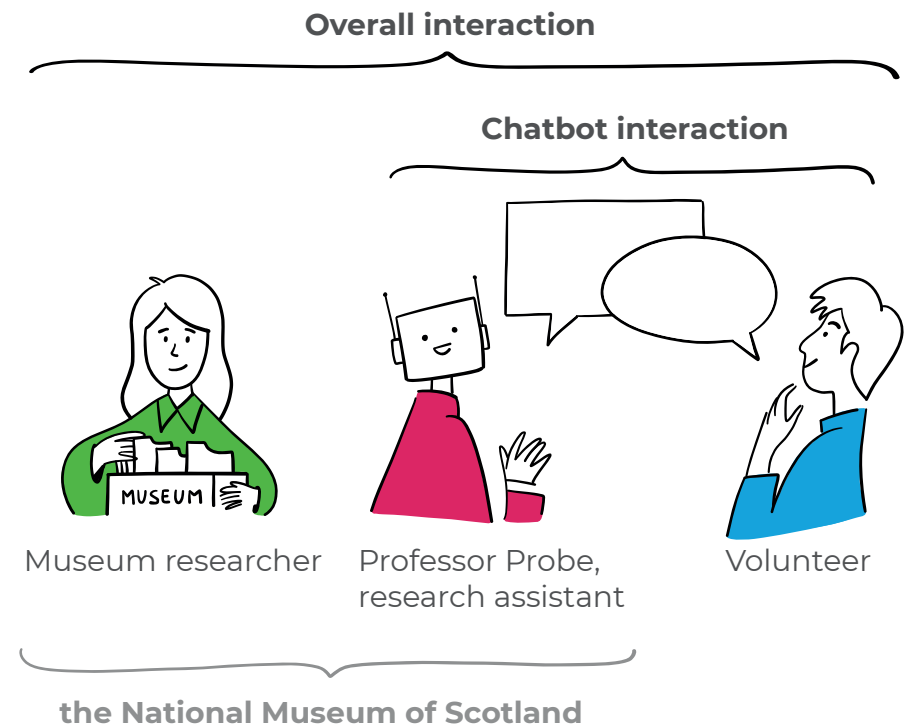


Figure 30: Interaction between the involved parties

## 6.2 The use

### 6.2.1 Overall interaction

In Figure 31, the overall interaction between Professor Probe, the museum, and the volunteer is shown. From the start, where the museum keeps the Professor up to date, to the end, where the volunteer and the museum start co-creating a new citizen science project.

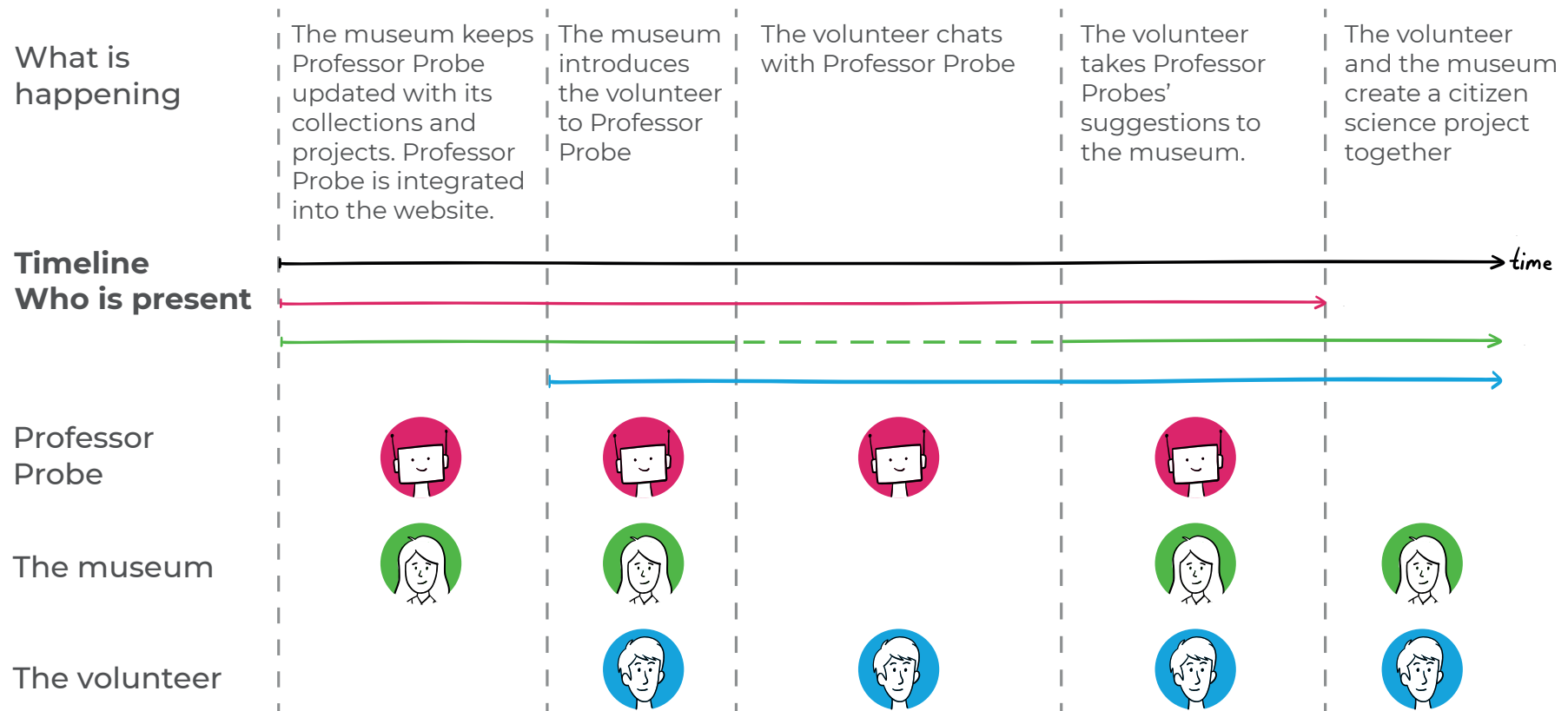


Figure 31: Overall interaction

## 6.2.2 Chatbot interaction

Every conversation with the chatbot is different. Below is an example of how a conversation can look. The blue icon shows the volunteer's input, and the pink icon shows the chatbot's reaction.

*Hi Professor Probe. I want to start a new citizen science project with the museum, can you help me out?*



Hello! Of course, I'd be happy to help you with your new citizen science project at the museum. Do you have any ideas in mind for a topic?

*No, not yet*



That's alright! Let's start by thinking about what you enjoy or find interesting. Do you have any hobbies or interests that we could explore as a potential topic for your citizen science project?

*I like pottery, but I don't know if that is something the museum has*



Pottery is a fascinating subject! The National Museum of Scotland does have a rich collection that includes ceramics and pottery from different time periods and cultures. We could definitely incorporate pottery into your citizen science project. Here are a few possible directions we could explore:



1. Cataloguing and documentation: We can work on cataloguing and documenting the museum's pottery collection. This would involve examining and documenting details such as the type of pottery, its age, origin, and any distinguishing features.

2. Conservation and preservation: We could focus on studying the preservation needs of the pottery collection. This would involve assessing the condition of the pottery items, identifying any damage or deterioration, and suggesting conservation strategies to help preserve them.

3. Pottery production techniques: We could delve into the study of traditional pottery production techniques. This could involve research, interviews, and practical experiments to understand the processes and materials used in creating specific pottery items in the collection.

These are just a few ideas to get us started. How do they sound to you? Do any of them catch your interest?

*The second option sounds interesting!*





Great! Conservation and preservation of the pottery collection can be a valuable and engaging focus for your citizen science project. Now let's work on formulating a research question that will guide your project.

A good research question for your project could be:

**"What are the common conservation challenges and preservation needs of the pottery collection at the National Museum of Scotland?"**

This question will allow you to examine the condition of the pottery items in the collection, identify any common issues or challenges they face in terms of preservation, and propose possible solutions or conservation strategies.

Are you comfortable with this research question, or would you like to make any adjustments or additions to it?

*Can we do something with pottery that is specific to Scotland?*



Absolutely! We can focus on pottery specific to Scotland for your citizen science project. Let's modify the research question to align with this specific interest. How about this research question: **"What are the distinct conservation challenges and preservation needs of Scottish pottery in the collection at the National Museum of Scotland?"**

With this question, we can explore the unique characteristics, techniques, and materials used in Scottish pottery, as well as the preservation challenges that may arise due to regional factors or cultural



practices. This research question will provide valuable insights into the maintenance and conservation of Scottish pottery within the museum's collection. Does this modified research question resonate with you? If so, we can move forward with this topic.

*Yes sounds good*



Fantastic! I'm glad you're excited about the topic. Here's a short recap of what we have discussed:

Topic: **Conservation and preservation of Scottish pottery in the collection at the National Museum of Scotland.**

Research Question: **"What are the distinct conservation challenges and preservation needs of Scottish pottery in the collection at the National Museum of Scotland?"**

With this project, you will have the opportunity to delve into the unique characteristics and preservation requirements of Scottish pottery within the museum's collection.

Please feel free to use this recap when communicating with your contact person at the museum. They will appreciate having a clear understanding of your project proposal. If you have any further questions or need additional assistance, don't hesitate to reach out. Good luck with your citizen science project, and thank you for your dedication to contributing to the museum's research efforts!

## 6.2.3 Implementation website

Professor Probe is integrated on the museums website, as you can see in Figure 32.

The image displays two screenshots of the National Museum of Scotland website. The top screenshot shows the 'Volunteer' page, which features a large blue header with the museum's name and a navigation menu. Below the header, there is a section titled 'Volunteer' with a welcome message and a cartoon character named Professor Probe. The bottom screenshot shows a chat interface for Professor Probe, with a message box and a text input field.

**National Museum of Scotland**

Your account Basket Shop Search [Become a Member](#)

Visit What's on Collections Discover Schools Our impact Support us [Volunteer](#)

# National Museum of Scotland

Your account Basket Shop Search [Become a Member](#)

## Volunteer

Welcome to the volunteer platform! Professor Probe, our virtual research assistant, is happy to help you with your Citizen Science Project. Just let the Professor know you want to start a new project, and the conversation will go from there.

**My name is Professor Probe and I am here to help you. Nice to meet you!**

**National Museum of Scotland**

Plan your visit What's on See and do Families

You are here: [Home](#) > Volunteer

**Professor Probe**

Hello, and welcome to the volunteer platform! I'd be happy to help you with your new citizen science project at the museum. I can help you find a topic and a research question that fits your interests. Just ask me a question, and I will lead the way.

Type your message here...

Figure 32: 'Professor Probe' integrated in the website

## 6.3 Validation

To validate this design, a user test was conducted. The user test is done to investigate the design guidelines of the chatbot interaction. Some of the design guidelines of the overall interaction were validated through conversations with members of the communities and crowds project. Other still have to be validated in further research.

### 6.3.1 User test

This user test aims to investigate if the chatbot works as desired. This is done by exploring the design requirements of the chatbot interaction. The objective is to determine whether the design supports finding a research topic and helps formulate a research question. The volunteer should feel in control of this process and, in the end, feel more like a project creator than a project participant. To find an answer to these objectives, the participants try to impersonate themselves as the target group and converse with the chatbot. After this conversation, they answer a short questionnaire with the following questions;

#### Test setup

The test was conducted in person and began with an introduction to the target group, explaining who they are and their connection to the museum. This helps the participants relate more to the target group so they can try to mimic them. The participants were then informed about the purpose of their interaction with the chatbot, which was directly related to the assigned task. This task was to choose a topic for a research project and formulate a corresponding research question, all while thinking out loud to share their thought process. After completing the task, the participants completed a questionnaire (Figure 33) and explained their responses.

#### Limitation of the test

The target group of this design intervention is very small, making it challenging to find participants who fit the exact target group. That is why the results of this test could be more accurate. However, doing this test, even with people who are not the exact target group, still gives quick insights into what essential elements of the interaction are and what is missing in the design.

#### Questionnaire rating the chatbot

The chatbot helps me with finding a project topic that interests me  
Very low        Very high

The chatbot helps me with formulating a research question  
Very low        Very high

The chatbot makes me feel in control of the project  
Very low        Very high

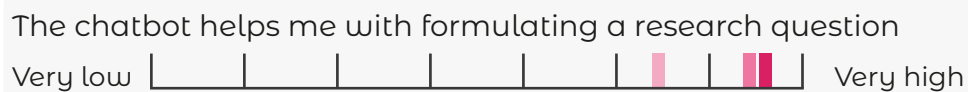
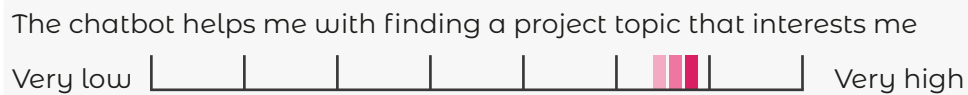
I identify more with the role of...  
project participant        project creator

Figure 33: Questionnaire rating the chatbot

## 6.3.2 Chatbot interaction

After the test, the participants (Figure 34) filled in the questionnaire, where each question relates to one of the design guidelines for the chatbot interaction.

### 4. The design should support finding a research topic and formulating a scientific question that fits within the interests of the volunteers.

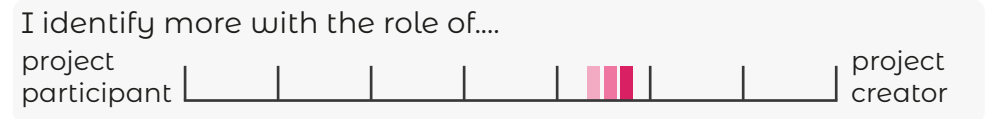


All participants said that the chatbot helped them find a topic that interested them and helped them formulate a research question. However, there was a small amount of apprehension because the participants said that they never knew if they had found the most exciting topic and if there was not something they would instead do but did not know.



Figure 34: Participants

### 5. The design should make the volunteer feel like a project creator instead of only a participant.



All participants felt a bit more like a project creator than a project participant.

### 6. The design should make the volunteer feel in control of finding a topic and formulating a research question.



Two of the three participants felt very in control, but one was neutral. This was partly because they did not know what the museum was looking for, making them hesitant about the topic they chose for the project.

### 6.3.3 Overall interaction

The guidelines on the overall interaction were not tested with the user test. Some of these can be concluded with knowledge of previous conversations with the museum and the communities and crowds project, but others have to be discovered in further research.

#### 1. The design should fit within the museum's project boundaries.

In one of the smaller user tests with the supervisors of this project, also researchers, the conversation was tested with a focus on the quality of the research question. The conclusion was that these research questions were of a high quality and could be used in citizen science projects of a museum. But this should also be confirmed by a researcher in the museum. So further testing with the researchers of a museum is needed to confirm that it is accurate enough.

#### 2. The design must add value to all participants, citizen scientists, and professional scientists.

As an addition to the previous guideline, the design must add value to all participants. Meaning that for the museum the tool should provide achievable projects, and for the citizen it has to provide a research question that fits within their interest. The value for the citizen was tested in the user test, but the value for the museum is something that has to be tested in further research.

#### 3. The design should facilitate a close collaboration between scientists and volunteers.

To find out if the tool facilitates a close collaboration, a case study needs to be done using the developed tool.

### 6.3.4 Conclusion

This graduation project started with exploring how to give people who volunteer a voice and design something that can realize the ambitions or goals of the people who work with collections, helping them tell the stories they want to tell. That led to the following design goal: To design something that supports the co-creation and execution of a citizen science project with volunteers and museum researchers. This meant lowering the barrier for volunteers to start collaborating on a citizen science project and helping them formulate a suitable research question for the project. Professor Probe, the virtual researcher, does both of these things. Because the virtual assistant can help the volunteer in their own time with creating a topic and research question, the barrier to starting a project is lower. The tool gives the volunteers a start on their project so they can feel more confident in their abilities before collaborating with the museum.





# Discussion

In this discussion, I reflect on the collected data and examine how these insights have shaped this project.

The data in the report comes from literature research, with additional data from interviews and a questionnaire. The literature gives a broad overview of the theoretical side of citizen science and volunteering, and the additional research complements how this theory comes into practice. Speaking to project leaders and volunteers in the citizen science projects from Naturalis was helpful because it was easy to connect with them. It would be great if I also had more close contact with the volunteers at The National Museum of Scotland because they are the real target group of the design. The same goes for the user test; in the ideal situation, the target group would also be the one to test the design.

Despite being introduced late in my project, the questionnaire proved to be a valuable addition to the research. It confirmed a significant amount of information on volunteers already present in the literature, enhancing our understanding of the subject.

# **Recommendations**

The recommendations are divided into recommendations for the project and recommendations for the design.

## Design recommendations

- For the design, I recommend that the chatbot is tested again with the final user group and in combination with the museum researchers. To see if it can be used in the designed context
- The design could be made applicable to other institutions, like museums and archives, or it could be used to develop research questions for University projects. Applying the chatbot in other contexts means it should also be tested there.
- Further research should be conducted on implementing the chatbot on the website and keeping it up to date. You can provide additional documents to the chatbot to give more information on the collection and past projects, making the chatbot's responses even more accurate.

## Project recommendations

- This project formulated five possible design directions. This project continued with only one, but the others could also make for interesting projects. Of all the directions, I would recommend exploring the third design direction. It focuses on a community-driven data citizen science project, which has not yet been done in this way, and I think that it will reach a new group of volunteers.

# Reflection

The project started while I was on exchange. That did not hinder the contact with the supervisory team because the team was formed quickly. Formulating the project brief was more complex than expected. Choosing to work on the topic of citizen science was very clear from the beginning, but there still needed to be a clear problem definition or assignment. In hindsight, it took a long time, even during the project, to figure out what exactly the problem was that needed a design intervention, but once this was clear, it was very satisfying to see everything come together.

It was a new experience for me to work with a company overseas, and I learned a lot from it which I did not expect in the beginning. The team at The National Museum of Scotland and Zooniverse were very welcoming and excited about the collaboration. However, working with a company so far away was also a barrier. It is more difficult to reach the target group and get quick feedback on the design. That was why it was beneficial to also have close contact with Naturalis here in Leiden. It helped to speak to many people involved in these kinds of volunteer projects.

It was also inspiring to work so close to the Communities and Crowds project. The toolkit they are developing looks very promising, and I hope museums will use this toolkit to create their own citizen science projects with volunteers. I also hope my project will inspire people to think outside the box and see the value of involving volunteers early in the process.

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# APPENDIX

- A: PROJECT BRIEF
- B: QUALITY CRITERIA FOR CITIZEN SCIENCE
- C: INTERVIEW GUIDES
- D: QUESTIONNAIRE
- E: CLUSTERS & STATEMENTS
- F: STATEMENTS
- G: BRAINSTORMING

# A: PROJECT BRIEF



## IDE Master Graduation Project

### Project team, procedural checks and Personal Project Brief

In this document the agreements made between student and supervisory team about the student's IDE Master Graduation Project are set out. This document may also include involvement of an external client, however does not cover any legal matters student and client (might) agree upon. Next to that, this document facilitates the required procedural checks:

- Student defines the team, what the student is going to do/deliver and how that will come about
- Chair of the supervisory team signs, to formally approve the project's setup / Project brief
- SSC E&SA (Shared Service Centre, Education & Student Affairs) report on the student's registration and study progress
- IDE's Board of Examiners confirms the proposed supervisory team on their eligibility, and whether the student is allowed to start the Graduation Project

#### STUDENT DATA & MASTER PROGRAMME

Complete all fields and indicate which master(s) you are in

Family name	ten Hagen	IDE master(s)	IPD	DFI	✓	SPD
Initials	P	Z <sup>nd</sup> non-IDE master				
Given name	Paulien	Individual programme (date of approval)				
Student number		Medisign				
		HPM				

#### SUPERVISORY TEAM

Fill in the required information of supervisory team members. If applicable, company mentor is added as 2<sup>nd</sup> mentor

Chair	Jeff Love	dept./section	HICAI
mentor	Maarten Wijntjes	dept./section	HICD
Z <sup>nd</sup> mentor			
client:			
city:		country:	
optional comments			

! Ensure a heterogeneous team. In case you wish to include team members from the same section, explain why.

! Chair should request the IDE Board of Examiners for approval when a non-IDE mentor is proposed. Include CV and motivation letter.

! Z<sup>nd</sup> mentor only applies when a client is involved.

#### APPROVAL OF CHAIR ON PROJECT PROPOSAL / PROJECT BRIEF -> to be filled in by the Chair of the supervisory team

Sign for approval (chair)

## Personal Project Brief – IDE Master Graduation Project

Name student Paulien ten Hagen

Student number

### PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT

Complete all fields, keep information clear, specific and concise

#### Project title

Involving volunteers in different stages in citizen science projects by museums

*Please state the title of your graduation project (above). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.*

#### Introduction

*Describe the context of your project here; What is the domain in which your project takes place? Who are the main stakeholders and what interests are at stake? Describe the opportunities (and limitations) in this domain to better serve the stakeholder interests. (max 250 words)*

The motivation to volunteer can be different for everyone. People can do it to give back to their community, or they can do it to gain skills in a particular subject. But one of the most important reasons is to help others, and feel useful (Anderson, 1979). In this project I'm looking at museum volunteers. There are many different ways to volunteer in a museum, but the focus here is on the volunteers that participate in citizen science projects. In a lot of the current citizen science projects the volunteers mainly help with collecting data for research. These projects can all differ in how accessible it is to join, and the level of expertise that is needed. Next to gathering data for research, another goal for citizen science projects can be to create awareness for a certain subject. In the case of Naturalis, this can be to create awareness about the life of the wild bees in the Netherlands. They do this in their National Bee Counting project. They also have project about counting shells, and about checking the plants in river banks.

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introduction (continued): space for images

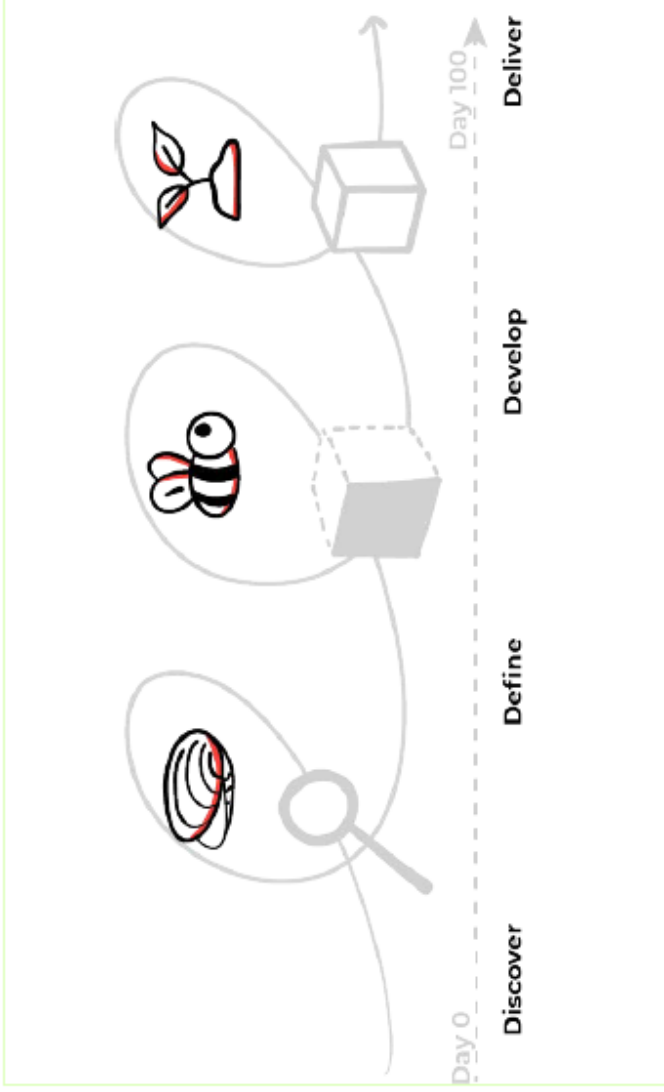


image / figure 1

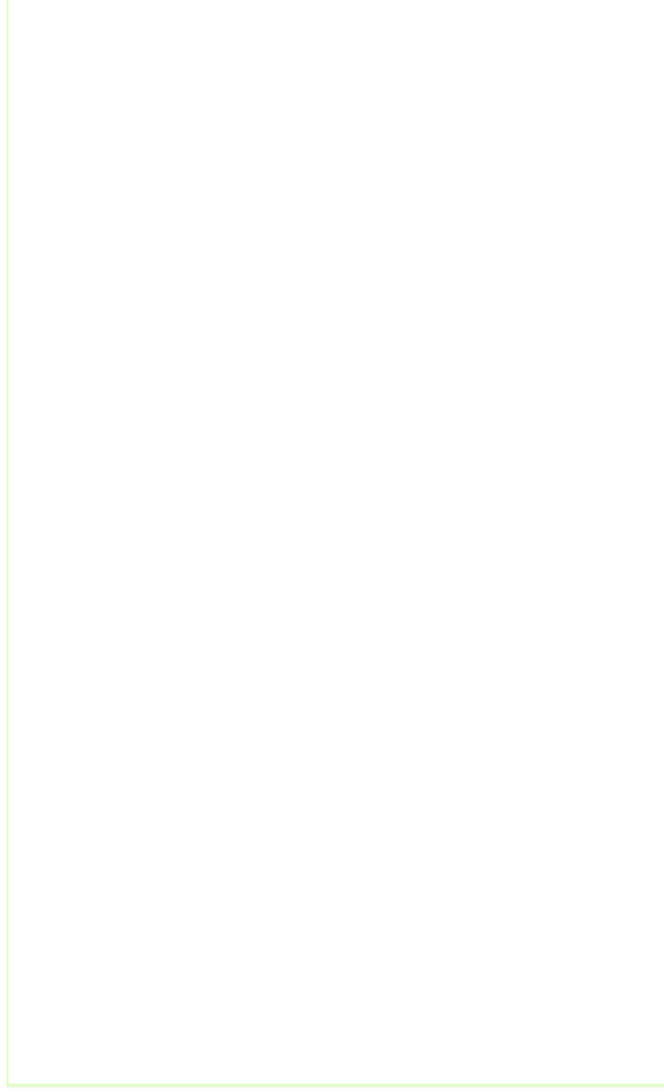


image / figure 2

## Personal Project Brief – IDE Master Graduation Project

### Problem Definition

*What problem do you want to solve in the context described in the introduction, and within the available time frame of 100 working days? (= Master Graduation Project of 30 EC). What opportunities do you see to create added value for the described stakeholders? Substantiate your choice.  
(max 200 words)*

The participation in citizen science projects is increasing. For research projects to have a bigger impact, they generally strive for outcomes that fall into one or more of the following categories: outcomes for research (scientific findings), outcomes for individual participants (acquiring new skills or knowledge), and outcomes for social-ecological systems (influencing policies). Citizen science projects don't always acknowledge these three categories of outcomes, which results in a project not always being able to address complex problems (Shirk, 2012). Shirk also states that the degree in which volunteers participate in research projects, as well as the quality of that participation, are closely related to the outcomes of those projects. A common framework can have a positive impact on these citizen science projects.

Addressing all three categories while creating a citizen science project can create an opportunity for deeper engagement of the volunteers with the project. Additionally, a higher skill level can contribute to a higher data quality (Haklay, 2018). So it is valuable for citizen science projects and the volunteers to match in interest and skill level.

### Assignment

*This is the most important part of the project brief because it will give a clear direction of what you are heading for. Formulate an assignment to yourself regarding what you expect to deliver as result at the end of your project. (1 sentence)  
As you graduate as an industrial design engineer, your assignment will start with a verb (Design/Investigate/Validate/Create), and you may use the green text format:*

Design a prototype / framework that helps involve volunteers in different stages in a citizen science project of museums. This prototype focusses on the knowledge and skills of the volunteers, so they can contribute in a more meaningful way.

*Then explain your project approach to carrying out your graduation project and what research and design methods you plan to use to generate your design solution (max 150 words)*

During this whole project I will study three citizen science projects of Naturalis. These are the Schelpenteldag (23<sup>rd</sup> of March), the Nationale Bijjentelling (15-24<sup>th</sup> of April), and the Oeverplanten check (15<sup>th</sup> of May - 15<sup>th</sup> of September). I will do quantitative (Interviews, auto ethnography) and qualitative (Microsoft form through Naturalis) research during the first two cases. I will start making prototypes for the second case, and iterate to test and validate in the last case as well. I want my final design to be applicable for different citizen science projects in different museums, which is why I will use different cases during this project. (Figure 1)



### Project planning and key moments

To make visible how you plan to spend your time, you must make a planning for the full project. You are advised to use a Gantt chart format to show the different phases of your project, deliverables you have in mind, meetings and in-between deadlines. Keep in mind that all activities should fit within the given run time of 100 working days. Your planning should include a **kick-off meeting**, **mid-term evaluation meeting**, **green light meeting** and **graduation ceremony**. Please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any (for instance because of holidays or parallel course activities).

Make sure to attach the full plan to this project brief.  
The four key moment dates must be filled in below

Kick off meeting	12 feb 2024
Mid-term evaluation	18 apr 2024
Green light meeting	27 juni 2024
Graduation ceremony	1 aug 2024

In exceptional cases (part of) the Graduation Project may need to be scheduled part-time. Indicate here if such applies to your project

Part of project scheduled part-time	
For how many project weeks	
Number of project days per week	4,0

Comments:

### Motivation and personal ambitions

Explain why you wish to start this project, what competencies you want to prove or develop (e.g. competencies acquired in your MSc programme, electives, extra-curricular activities or other).

Optionally, describe whether you have some personal learning ambitions which you explicitly want to address in this project, on top of the learning objectives of the Graduation Project itself. You might think of e.g. acquiring in-depth knowledge on a specific subject, broadening your competencies or experimenting with a specific tool or methodology. Personal learning ambitions are limited to a maximum number of five.  
(200 words max)

What I want to learn / focus on

- Using visuals to tell a story, in the form of illustrations and photographs
- Learn and use a new method of research: auto ethnography
- Be assertive in contacting / meeting with new people
- Get confident in presenting

## B: QUALITY CRITERIA FOR CITIZEN SCIENCE

Set of criteria	Specific criterion	Based on principle	References				
What is not citizen science	A. The catalogue excludes projects that exclusively involve people with project-specific professional and scientific backgrounds.	EP1	Cohn 2008; Haklay 2013; Sanz et al. 2014	Communication	12. Different interest groups are addressed accordingly.	VP6	Bonney et al. 2009; Pace et al. 2010
	B. The catalogue excludes projects by professional scientists or scientific institutions, in which people are merely interviewed regarding their opinion/attitude, way of life, etc.		Haklay 2013		13. Contact details (e.g. e-mail address, phone number or contact form on the website) are easy to find, in case of questions or feedback. Interaction between project management and citizen scientists must be possible at all times.		Newman et al. 2010
	C. The catalogue excludes projects by professional scientists or scientific institutions, which merely collect data on participants.	EP1	Haklay 2013		14. Citizen scientists receive feedback on the progress and the results of the project.	VP5; EP5	Mackechnie et al. 2011
	D. The catalogue excludes projects by professional scientists or scientific institutions, in which participants provide resources only passively.		Wiggins and Crowston 2011		15. The project results are published in a generally comprehensible manner.	VP6	Bonney et al. 2009
Scientific standards	1. There must be a stated scientific question, hypothesis or goal that can be answered, tested or achieved with the project.	VP10; EP2		Ethics	16. The project objectives must be ethically sound (i.a., in compliance with human and basic rights).	EP10	European Parliament 2000
	2. The methods must be presented in a field-specific, appropriate and comprehensible way.	VP8			17. The project must follow transparent ethical principles in compliance with ethical standards, such as obtaining informed consent from participants or the parents of participating children, among others.	EP10	Kupper et al. 2015
	3. New knowledge must be generated (e.g. improved understanding of certain relationships), or new methods developed.	VP10; EP2			18. Clear information on data policy and governance (regarding personal and research data) must be published within the project, and participants must consent to this information prior to participation.	EP10	Kupper et al. 2015
Collaboration	4. There must be an added value for all participants, both citizen scientists and professional scientists.	EP3	Tweddle et al. 2012	Data management	19. Project management must reflect and consider ethical aspects (e.g., diversity, inclusion, gender equality, reflection on in- or exclusion of specific groups).		Kupper et al. 2015
	5. The objectives of the project must be unachievable without the citizen scientists' collaboration.		Lave 2012		20. Prior to data collection, all projects must have established a data management plan which conforms to the European General Data Protection Regulation.		European Research Council 2017
Open Science	6. Citizen scientists must be involved during at least one project element. Common elements of research projects include: · Search for a topic and formulation of research questions · Method design · Data collection · Data analysis and interpretation · Publication and communication of results · Project governance	VP7; EP1&4	Shirk et al. 2012				
	7. The project definition and objectives are open, clear, easily found and communicated in a generally comprehensible manner.	VP6	Tulloch et al. 2013				
	8. The assignment of tasks must be clear and transparent.		Newman et al. 2010				
	9. All data and metadata is made publicly available, provided there are no legal or ethical arguments against doing so.	VP1–4&12; EP7	European Research Council 2017; Wilkinson et al. 2016				
	10. The results are published in an open-access format, provided there are no legal or ethical arguments against doing so.	VP1–4&12; EP7	Berlin Declaration 2003; Chan et al. 2002; European Research Council 2017				
	11. The results are findable, reusable, comprehensible and transparent.	VP1–4	Berlin Declaration 2003; Chan et al. 2002; European Research Council 2017; Wilkinson et al. 2016				

The table is based on (Heigl et al. 2018b). Wording appears exactly as in the published criteria.

## C: INTERVIEW GUIDES

Project leader 'Oeverplantencheck' (2024-03-04)  
Co-director Zooniverse (2024-03-06)  
Project leader 'Schelpentelling' (2024-03-11)  
Data Scientist 'Nationale bijtelling' (2024-03-14)  
Volunteers 'Schelpentelling' (2024-03-23)  
Keeper of Science and Technology at NMS (2024-04-04)  
Volunteer Coordinator at NMS (2024-06-05)

### Project leader 'Oeverplantencheck' (2024-03-04) & 'Schelpentelling' (2024-03-11)

#### Project

- Wat is je rol / functie in dit project?
- Wat zijn je taken?
- Hoe zet je zo'n project op? Hoe ziet de tijdlijn er uit? Hoe ver van te voren begin je met het opzetten?
- Wie zijn er allemaal betrokken in dit project. (Gemeentes, onderzoekers, universiteiten)
- Wat is het doel van dit project? Alleen data vergaren of nog meer?
- Wat doen jullie met de data? En hoe zorgen jullie ervoor dat de kwaliteit van de data hoog is?
- Wie maakt het materiaal voor de vrijwilligers

#### Vrijwilligers

- Wanneer betrekken jullie vrijwilligers, en waarvoor?
- Hoe bereiken jullie de vrijwilligers
- Hoe loopt het contact met de vrijwilligers? Zijn jullie actief in zoeken, zijn het vaak dezelfde vrijwilligers die elk jaar terug komen?
- Ik ben geïnteresseerd in mijn project in het betrekken van vrijwilligers in verschillende fases van een citizen science project. Zie jij dit als iets waardevols, en als je er nu over denkt, waar zou je ze dan betrekken?

#### Overig

- Is het project volledig fysiek, of zijn er ook onderdelen die online worden gedaan?
- Wat zijn dingen waar jullie tegenaanlopen?
- Zien jullie problemen in de toekomst voor dit soort projecten? Of juist nieuwe kansen?
- Zijn er dingen die we niet hebben besproken die wel belangrijk zijn?

## Co-director Zooniverse (2024-03-06)

- What do you do for Zooniverse, what is your role?
- Do you see design challenges for the future of Zooniverse?
- Do you have hybrid projects? Where people can take pictures and others can analyze them?  
A combination of digital and physical
- What does the volunteer involvement look like now?
- In my project, I want to look at involving volunteers in different stages of a citizen science project, not only in data gathering and analyzing. Do you see opportunities here?
- Do you have problems reaching scientists in your projects? How accessible is it to start a project?
- What is the process of starting a new citizen science project on Zooniverse?
- What are the current disciplines that have projects on Zooniverse, and is this changing?
- Are there things the researchers or the volunteers encounter while doing a project on Zooniverse?

## Volunteers 'Schelpentelling' (2024-03-23)

### Vrijwilligers

- Waarom ben je vrijwilliger geworden?
- Wat vind je het leukste aan hier helpen / staan?
- Wat is het gekste wat je bent tegengekomen vandaag?
- Heb je al vaker geholpen bij de schelpentelling?

### Deelnemers

- Hoe wist je van de schelpentelling af?
- Waarom doe je mee vandaag?
- Wat is gekste wat je bent tegengekomen vandaag?
- Denk je dat je volgend jaar weer mee doet?

## Data Scientist 'Nationale bijentelling' (2024-03-14)

### Project

- What is your role / function in this project?
- What are your tasks?
- How do you start a project like this? When do you start promoting, gathering people?
- Who are involved in this project? Different researchers, organisations?
- What is the goal of this project? Is it just gathering data or do you have a different goal as well?
- How do you process the data? And how do you ensure that the quality of the data is high enough so you can use it?

### Volunteers

- When do you involve the volunteers?
- How do you reach the volunteers?
- What is the contact with them? Are you active in searching for them? Do the same people come back each year?
- One of the goals of my project is involving volunteers in different stages of a citizen science project. Do you see any opportunities for this? Or do you see other opportunities that could benefit a project like this?

### Overig

- Are there things you encounter that don't work that well, or would work very well?
- How do you see the future of this project?
- Are there any important things we haven't talked about that could be interesting?

## Keeper of Science and Technology at NMS (2024-04-04)

- What do you do for the museum, what is your role?
  - Can you tell me more about the toolkit you are making?
  - What do you think are the biggest differences between online and in-person volunteering? And do you have a clear image of who your volunteers are? Are they quite different from each other, or do they fit the same profile?
  - Do you think the toolkit is applicable for different kinds of CS projects?
  - I heard you are thinking about making the toolkit available to more institutions, what do you think is needed for that? Which elements of the toolkit are specific to what you are doing, and need to be made broader?
  - What do you think would be interesting for me to focus on, do research on, or design?
  - Do you (How?) involve different parties in your CS projects, or are you only working within the museum?
  - Join midterm??
  - Do you see design challenges for the future of Zooniverse?
  - Do you have hybrid projects? Where people can take pictures and others can analyze them?
- A combination of digital and physical
- What does the volunteer involvement look like now?
  - In my project, I want to look at involving volunteers in different stages of a citizen science project, not only in data gathering and analyzing. Do you see opportunities here?
  - Do you have problems reaching scientists in your projects? How accessible is it to start a project?
  - What is the process of starting a new citizen science project on Zooniverse?
  - What are the current disciplines that have projects on Zooniverse, and is this changing?
  - Are there things the researchers or the volunteers encounter while doing a project on Zooniverse?

## Volunteer Coordinator at NMS (2024-06-05)

No interview guide

## D: QUESTIONNAIRE

### Intro text - Soft consent

Bedankt dat u wilt deelnemen aan deze enquête. Dit is een onderdeel van het afstudeeronderzoek genaamd “Samenwerking met vrijwilligers in onderzoeksprojecten”. Dit onderzoek wordt gedaan door Paulien ten Hagen van de TU Delft in samenwerking met het Nationale Museum van Schotland en Naturalis, als onderdeel van het Future Libraries Lab.

Het doel van dit onderzoek is het in kaart brengen van de ervaringen van vrijwilligers, en hoe ze hun expertise gebruiken in onderzoeksprojecten. Het invullen van deze enquête zal ongeveer 15 minuten duren. De data wordt gebruikt in het afstudeeronderzoek, en eventueel in verder onderzoek naar dit onderwerp. We vragen u om uw eigen ervaring te delen op het gebied van vrijwilligerswerk in het oeverplantenproject van Naturalis.

We doen ons uiterste best om het onderzoek vertrouwelijk te houden. We slaan de persoonlijke data op een veilige plek op. Als het onderzoek afgerond is worden de resultaten anoniem gepubliceerd. Uw contactgegevens worden alleen gebruikt voor interne onderzoeksdoeleinden.

Uw deelname aan dit onderzoek is vrijwillig en u kunt op elk moment stoppen.

### Questions & Reason for asking

#### **1. Ik doe graag mee aan de enquête**

[Informed consent]

#### **2. Hoe weet u van het bestaan van het oeverplantenproject af?**

[To find out if they know about it from related organizations, or via other projects. This could be interesting to know for setting up a new project and thinking about how to promote it]

#### **3. Hoeveel jaar heeft u al mee gedaan met het oeverplantenproject?**

[I want to know if people do this just once (to try it out for example), or if they are interested in working on a project for multiple years]

#### **4. Hoeveel oeverchecks heeft u gedaan bij uw laatste deelname?**

[There are participants who only check one oever, and participants who do multiple in a bigger area. I want to know how involved they are.]

#### **5. Hoeveel tijd heeft u in totaal besteed aan de oeverplantencheck bij uw laatste deelname?**

[This is related to question 4. To paint a bigger picture of how much time they spend working on this CS project]

#### **6. Als u het afgelopen jaar meer of minder oevers heeft gecheckt dan gebruikelijk, kunt u dan toelichten waarom?**

#### **7. Bent u van plan dit jaar weer mee te doen met de oeverplantencheck?**

[I ask this to check if I can ask them follow-up questions for this year, and maybe for testing later in the project]

**8. Doet u de oeverplantencheck alleen, of samen met iemand?**

[To find out if this is something they do purely to gather data, or if it has a social element in it as well]

**9. Hoe is bij u de interesse in het oeverplantenproject ontstaan?**

[Find out their motivation to participate]

**10. Wat vindt u het leukste aan meedoen met de oeverplantencheck?**

[Related to question 8, what elements of this project do they like? It is interesting to know what they like to do in current projects, for developing future projects]

**11. Als u iemand enthousiast wil maken voor het oeverplantenproject, wat zou u ze dan vertellen?**

[Maybe this will make the volunteers think about why they like to participate, and help them formulate their reasons]

**12. Welke functies vindt u belangrijk bij de app die u ondersteund bij de oevercheck?**

**13. In welke leeftijdscategorie valt u?**

[To get an overall overview of the demographic of the volunteers]

**14. Welke van de volgende categorieën omschrijft het beste uw arbeidssituatie?**

[To get an overall overview of the demographic of the volunteers. If they have overall more time for volunteer work in their life]

**15. Wat zijn uw hobby's, en wat doet u in uw vrije tijd?**

[Asking if they are interested in more subjects related to this project. Also helps with forming an overall image of why they participate]

**16. Heeft u het idee dat u vaardigheden of kennis bezit die iets waardevols bijdragen aan het oeverplantenproject? Zo ja, welke?**

[I want to know if the volunteers have particular skills they use now, and what they are]

**17. Heeft u vaardigheden of kennis die nu niet worden benut in het oeverplantenproject, die wel iets zouden kunnen bijdragen? Zo ja, welke?**

[I want to know if the participants think there are skills they have that are not being used now. This could be interesting in a future design intervention]

**18. Heeft u meegedaan / gaat u mee doen, met vergelijkbare projecten?**

[More background information on the volunteers. Is participating something they do because they like this particular topic, or are they volunteers in multiple CS projects]

## E: CLUSTERS & STATEMENTS



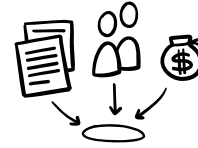
A Citizen  
Science Project

Statement: 48, 42, 41, 24,  
9, 7



Choose a topic  
and define the  
research question

Insights: 2.3.1 B  
Statement: 70, 63, 60, 48



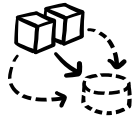
Gather information,  
resources and form  
a research team

Insights: 2.3.1 B  
Statement: 54, 52, 28, 5, 3, 1



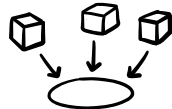
Develop  
hypotheses

Insights: 2.3.1 B  
Statement: 61



Design data  
collection method

Statement: 69, 61, 44, 38,  
26, 12, 4, 2



Collect the data

Statement: 56, 43, 39, 16



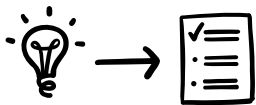
Analyse the data

Statement: 62, 43, 39, 25, 10



Interpret data and  
draw conclusions

Statement: 8



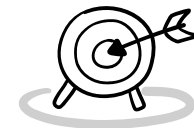
Translate results  
into actions

Statement: 66, 37, 23, 11



Discuss results and  
ask new questions

Statement: 2.3.1 B



Goal of doing  
a CS project

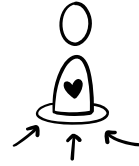
Insights: 2.3.1. A, 2.3.1 C  
Statement: 91, 86, 85, 68,  
67, 66, 60, 48, 45, 36, 35,  
34, 6





Volunteers

Insights: 2.3.1. A, 2.3.1 C  
Statement: 91, 86, 85, 68, 67, 66, 60, 48, 45, 36, 35, 34, 6



Reaching volunteers

Statement: 94, 78, 76, 59, 58, 49, 29, 15, 14



Volunteer community

Statement: 1, 93, 79, 77, 75, 74, 72, 59, 53, 40, 27, 20, 13



Valuing volunteers

Statement: 80, 50, 31, 19



Frequency

Statement: 95, 81, 71, 32, 17



Level of expertise

Insights: 2.3.1. G  
Statement: 96, 83, 82, 80, 73, 64, 33, 21, 18



Motivation

Insights: 2.3.1. E, 2.3.1. F  
Statement: 92, 90, 89, 88, 87, 84, 65, 30, 22



Toolkit NMS

Statement: 57, 55, 51



Communities and crowds project

Statement: 53, 48, 47, 46

## F: STATEMENTS

### Interview Project leader 'Oeverplantencheck'

1. First edition of CS project had a workshop for the volunteers
2. We did a pilot with volunteers to test the method
3. We did a brainstorm about developing the app
4. The method of CS project is formed in collaboration with experts & students
5. App is developed and maintained using money of the museum
6. The project is initiated by the municipality as an assignment for Naturalis
7. You are responsible as project leader. If I don't take the lead, the project won't happen
8. You cannot change the method of gathering the data after a project is started, but you can change how you process it
9. The project and the data that is gathered is 100% transparent
10. On the method of data gathering; volunteers compared with experts to check the quality of the data
11. The municipality can use the data but it is not clear when they do use it
12. If I look back to the beginning, I would change the data points
13. Difficult part of the method are explained in more detail
14. The volunteers come from partner organisations that are related to the subject of the CS project
15. The goal is not to get a lot of volunteers. We want to get volunteers that have the knowledge on the subject
16. For all the CS projects, 80 – 90% of the data gathered comes from a small group
17. There are volunteers that join a few times and then quit, but there are also volunteers who join every year
18. The volunteers are experts on the subject, but not professionals
19. I put a lot of time and effort in helping a volunteer, but in the end it paid off because she is still involved in the project
20. It would be ideal if volunteers could join new volunteers to support them

21. I would like volunteers to give workshops to new volunteers, because communicating the knowledge takes a lot of time
22. A few volunteers join every year to see a change in the biodiversity at their river side
23. The data is used for the research of the students

### Interview Project leader 'Schelpentelling'

24. A lot of CS projects only run for 2 years, and stop when the project leader leaves
25. The expert volunteers check the data that is gathered to ensure the quality
26. The method stays the same during the whole project
27. There can be improvement in the communication between all the different parties that are involved
28. A lot of time goes into getting everyone on the same page
29. The volunteers that are involved are reached through different associations
30. Using expert volunteers to motivate the participants
31. We use a lot of the same volunteers for different projects so we have to keep in mind to not "overuse" them
32. There are a lot of the same volunteers who come back to help each year. The people that join have the expertise on the subject
33. I like to join 2 experts and 2 new volunteers to help each other
34. A theme every year, to look for. Analyse the trends through the years
35. Goal is to collect data. To analyse the beach and how it changes of time
36. Teach the general public about biodiversity (In a low threshold way)
37. Partner organisations use the data in their policies or in their action points

## Interview Data Scientist at the ‘Nationale Bijtelling’

- 38. Ask volunteers what they need to collect the data
- 39. The data is super biased because of the people who participate
- 40. Naturalis is good at connecting different parties. But they don't focus enough yet on the interaction between the scientists and the volunteers
- 41. I want to more researchers who work with bees to join the project
- 42. I recommend a closer collaboration between the volunteer and the scientist
- 43. Scientist who analyse the data should also join in the gathering of the data. I didn't when I was working on the project and missed out.
- 44. Add more data points, for example about the motivation to participate, to add to the data collection
- 45. I think it is important for researchers to know about CS projects. It's an easy way to educate people about science

## Interview Keeper of Science and Technology at NMS

- 46. Culture heritage spaces tend to be good at getting people in the door. What museums tend not to be very good at is online profile work, for example citizen science. Zooniverse is very good in that area. But Zooniverse is not very good with starting from the perspective from the collection, the archive, the data set, or the volunteer.
- 47. In the project we looked at starting with a set of volunteers, so they become the drivers from what will get used/researched in a project. We've created 2 case studies where we have worked with a group of volunteers who have become the digitisers of the data.

48. "Ultimately the goal of the project is to allow the volunteers to become their own researcher, to ask their own questions, to drive their own way forward."

49. Both the National Science Museum and the National Museum of Scotland have a volunteer recruitment process. You apply for a kind of job description that's put online. Anyone can apply to become a volunteer. We want the volunteering to be beneficial for both the museum and the volunteer.

50. The science museum group has a list of criteria for making sure that a volunteer work has build in benefits for the volunteers, and you define that before the project. For some people it is a social activity, for some its a professional development benefit. They're looking to develop skills for museum work, so they can ultimately gain jobs in the museum sector.

## Interview Co-director Zooniverse

- 51. The toolkit will be in the form of a checklist
- 52. If you start with a large data set it we can turn it into an online crowdsourcing project
- 53. We want to know what online and offline volunteering can learn from each other
- 54. Are there existing data sets we can use as inspiration? In addition to the training in how to digitise data sets.
- 55. It would be interesting to apply the model (toolkit) to a bigger group of volunteers
- 56. Room for community driven data in the toolkit
- 57. Making the toolkit available to a broader range of institutions, like local community archives
- 58. We are choosing volunteers through the existing volunteer community and associations. The community grows because of new projects joining.

59. For some project we should look into specific communities rather than communicate it to the masses
60. We want volunteers to take the role of a project creator instead of a project participant
61. The focus of NMS is involving volunteers in choosing data, cause that is where they have been left out of.
62. What can the volunteers do with the data they have selected and digested? (Sam)
63. Focus on involving volunteers earlier in the process. Create a cs projet together with volunteers
64. A few of the volunteers had previous experience (Lived expertise)
65. Motivation of a volunteer can be to share information with a broader community
66. In Bradford there will be an exhibition about the project
67. It started by looking for new volunteer opportunities for the museum (small group of volunteer)
68. By adjusting the motivation to create a project, you end up with a different project trajectory
69. A smaller data set can lead to challenges. Creating the cs project isn't always the easiest to learn

### Interview Volunteer coordinator at NMS

70. We asked around if anyone in the museum had any collections that we could do a project on, and that's how we started with this project for the communities and crowds project.
71. With the last volunteer I asked if she has something that caught her eye where she would be interested in working on. It's hard for them because they work fulltime. They don't want to use all of their holiday leave, so maybe she wants to do something at home. Making it more accessible for other people as well.

72. When we get to the end of this project, I am not actively looking for someone, because you have to have something for them to work on. We have another volunteer, he has been coming in for 5 years, and he came in originally because he was a chemist. He is a specialist in that field, so he works with subjects like that, and continues to do so. We always try to find something different for them to work on.
73. The volunteers were taken on for a set amount of time for a project. We didn't really plan for after that. It does take a lot of time in terms of logistics. Most departments have their volunteers come in on set days. A lot of the volunteers have a certain expertise as well.

### Interview Volunteers 'Schelpentelling'

74. It is difficult to keep volunteers involved in your project (Volunteer 1)
75. Struggles are working with municipalities. Getting funding is easier when we are already working with other organisations (Volunteer 5)
76. It is difficult to reach some groups (Volunteer 1)
77. Our nature centre is part of a collective. The bigger connections make us stronger as an association (Volunteer 5)
78. I am not actively looking for new volunteer work, but I like it when they ask us in the group chat to join (Volunteer 1)
79. Some volunteers who work here are more independent and take more initiative, but they are rare (Volunteer 5)
80. Not everyone understand that we do this in our free time, even though we are experts at the subject (Volunteer 5)
81. I spend a few evenings a week on volunteering here (Volunteer 5)
82. There are some volunteers that have a background related to this work. A lot of people who are retired (Volunteer 5)

83. My volunteer work is very different from my day job.  
(Volunteer 5)
84. I like working on the beach more, but this is fun for 1 day. I like talking to the kids about all the subjects (Volunteer 4)
85. I love talking about what we do here. That's why I like to join  
(Volunteer 2)
86. I love talking about this subject and making people enthusiastic as well (Volunteer 1)
87. I also do a lot of other volunteer work. I like talking about nature and being in nature (Volunteer 1)
88. I became a volunteer to be more involved locally. My dad was already a volunteer here (Volunteer 5)
89. My wife asked me to join. I don't know anything about the subject, but I love to volunteer (Volunteer 3)
90. I'm joined by a friend. It is a good opportunity to catch up  
(Volunteer 1)
91. Goal of organisation is bringing people in contact with the surrounding nature (Volunteer 5)

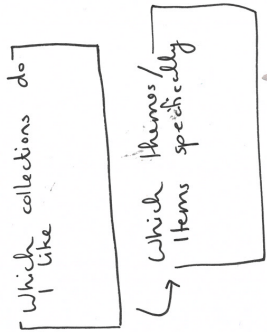
## Insights Questionnaire

92. The reason that the volunteers participate is that they want to know more about biodiversity in a specific area as well as be more involved in the (local) environment. They want to feel more valuable, like they can make a difference.
93. Some volunteers want to participate in the project together with a friend.
94. Most participants knew about the project because they follow the museum, or they read about it in a newspaper or a magazine.
95. 4 participants have participate once before, the other 7 have participated 2 or more times already.
96. A few participants use the knowledge they have on the subject. They are the not professional experts.

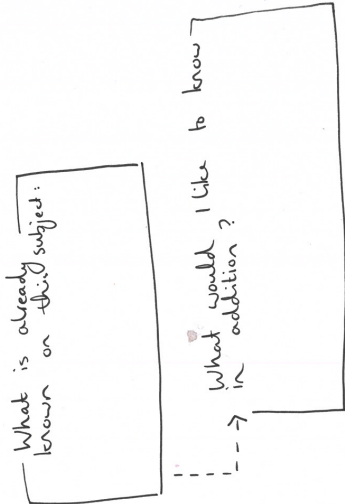
# G: BRAINSTORMING

Step-by-Step template to formulate a research question for a CS-project

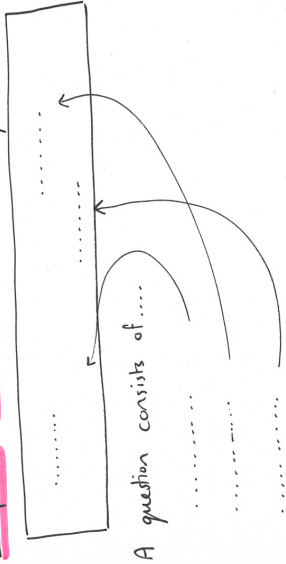
## Step 1. Identify your interest areas



## Step 2. Background Research



## Step 3. Formulate an initial question



## Step 4. Is this question SMART, and how can I make it SMART!

.....

## How to... Identify your interest areas

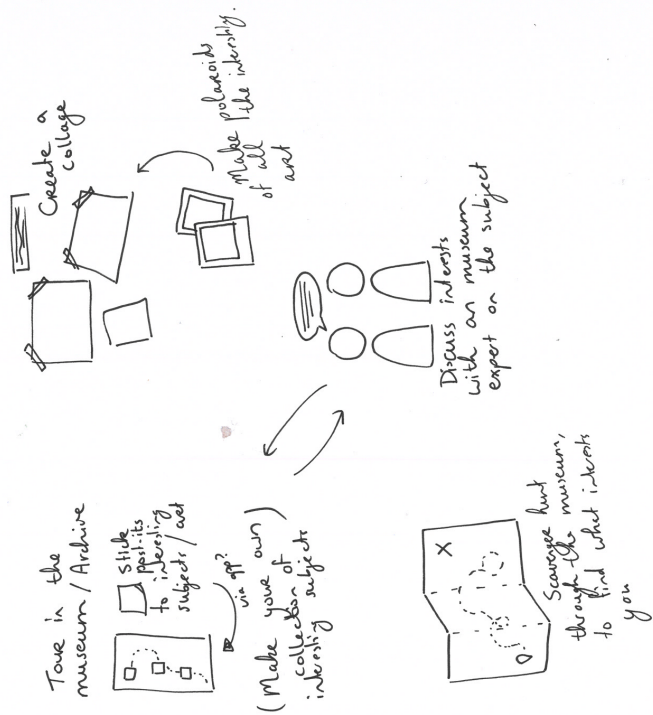
Reflect on Interests

- Our experiences
- Questions like... which collections do I like?

- Checklist
- topic 1
  - topic 2
  - topic 3



Make a timeline of your life and relate subjects of the museum to your personal life



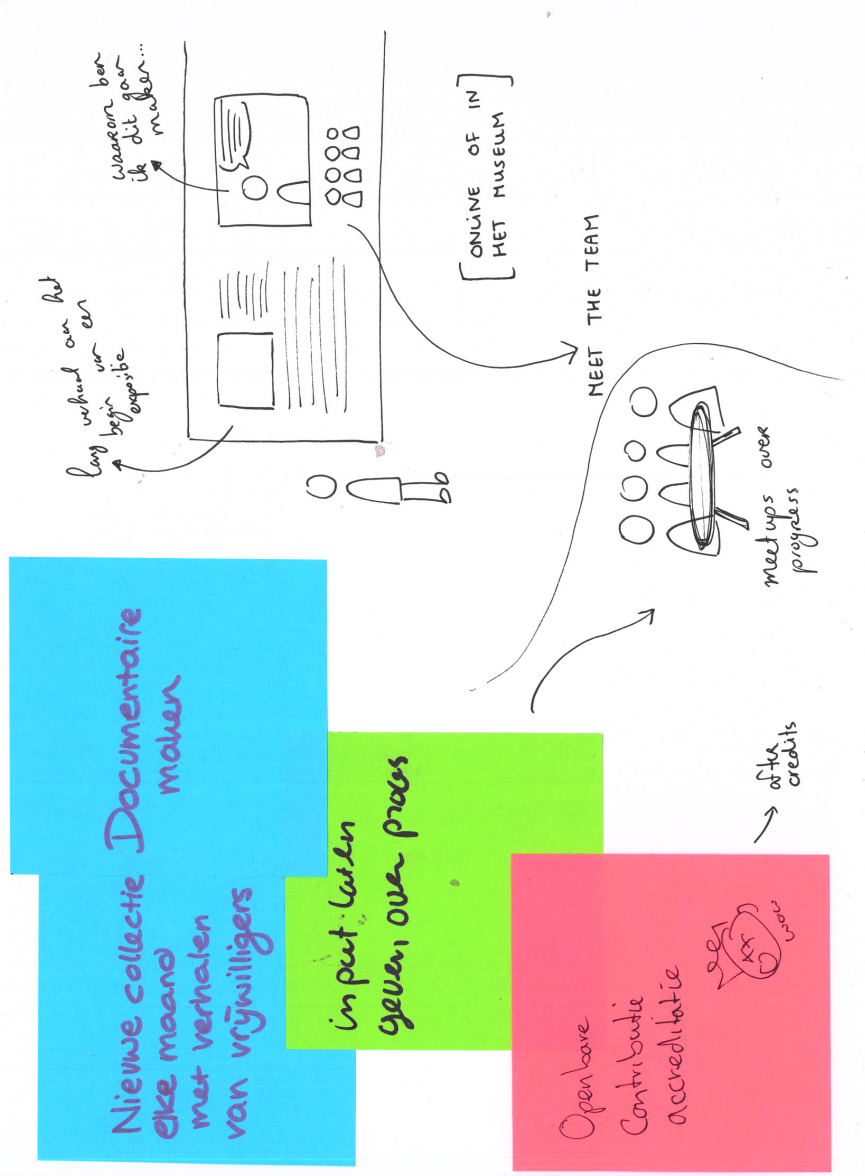
A new CS-project

With the National Museum of Scotland

What collections spoke my interest:

What did I like about them:

Are there things I want to know more about in this subject?

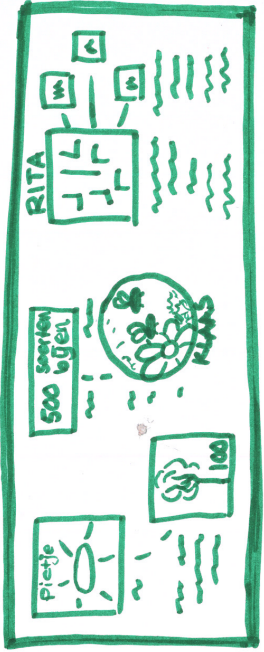


Privoord  
 Wall of vrijwilligers  
 + verhalen

continue  
 communicatie

Museum tour  
 (speurtocht/VR/  
 looproute/  
 audiotour)

# Wall of Volunteers



Maandelijks tour  
 door museum langs  
 de wall of volunteers/  
 van elke collectie/  
 onderwerp



Betrokkenheid

Deel maken van  
 het museum team.  
 Niet "we en ze"  
 maar "wij" zijn er

Positieve impact  
 van werk uitlichten

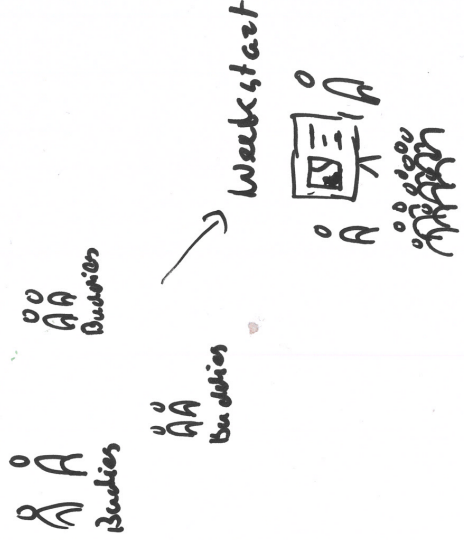


→ zelf stelsel

Buddy  
 systeem

collecties

Support the co-creation of  
 G.E.S. - project



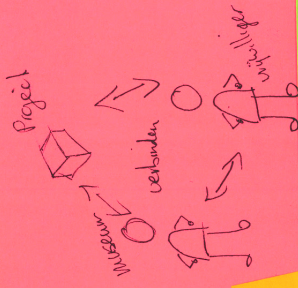


Collectie  
Tinder



goede combi's  
maken met  
vrijwilliger en hun  
interesse

interactieve  
verzameling



zelf het proces  
laten vormgeven

# Museum en ik

links of rechts?



- virtuele interactieve verzameling
- steeds een keuze uit twee opties
- welke is het meest interessant?



"meseum"

Competitief element:

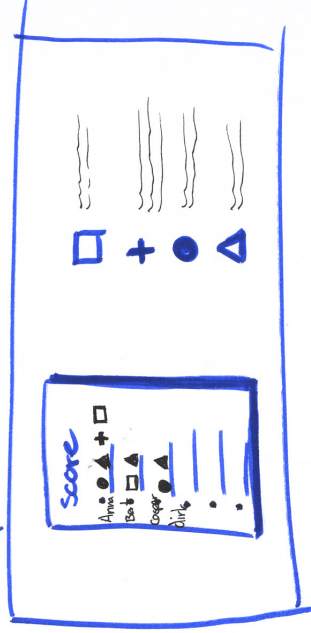
wie doet het meeste?



Verzamel alle stickers

Gamification  
-> rewards,  
punten verzamelen  
scoreboard

## Life at the museum.



□ je project heeft 1000 bezoekers getrokken.

+ je hebt een bij dragen geleverd aan de werkschap

○ je heb 200 bijen gekocht.

△ je hebt nieuwe vrijwilligers aangedragen

Interview met  
vrijwilliger

Co-~~ses~~ create  
sessies waar musea  
zelf onderwerpen  
mee naar toe nemen  
vanuit daar project  
opzetten

Zien wat het  
project te weeg  
brengt bij heroe-  
kers

Persoonlijke  
ervaringen met  
het onderwerp  
verwerken  
in het project

Open a  
connect  
tussen  
collectie  
belle

Schaude  
machi

Speeddates  
met  
collecties

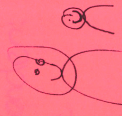
roadtrips  
langs  
collecties

tour door  
depot

Open avonden  
organiseren zodat  
mensen komen kijken  
naar het project.

Kaartset  


Geforceerd combineren  
Trek 3 boorden.  
Maak hier een proj. mee



Kindprojecten of  
neem een kind mee tijdens  
het project

EWI maanby oekland  
studie verzameling.

Dwingen, le moegen  
pas stoppen als

gratis museum  
bezoek  
voordat je  
vrijwilliger  
wordt

museum bezoek  
verplicht  
maken

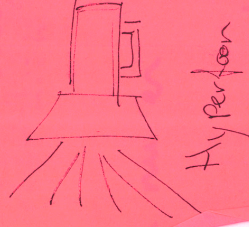
-Nativatie  
volunteers  
↳ initiatief  
Match volunteer  
met experts

Dash board met  
voortgang, accumulatie  
lopende projecten en  
toekomststof

Al-bot van  
elke collectie  
maken

goede lunch

Lunch  
Lezingen



Hij Perfoon

idea:  
Expert sessies,  
lunchje met mensen erin  
die ideeën hebben, om ze  
op gang te helpen.